A TREATISE

ON THE

PETROLEUM ZONES OF ITALY.

BY

E. ST. JOHN FAIRMAN, F.G.S., F.R.G.S.,

FELLOW OF THE GEOLOGICAL SOCIETY OF FRANCE AND THE SOCIETY OF NATURAL SCIENCES OF MILAN,

KNIGHT OF THE ITALIAN ORDER OF SAINTS MAURICE AND LAZARUS,

ETC., ETC., ETC.

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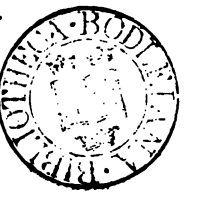

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TO

JOHN PHILLIPS, Esq., M.A., LL.D., D.C.L., F.R.S, etc.,

Professor of Geology in the University of Oxford,

AND

DAVID THOMAS ANSTED, Esq., M.A., F.R.S., etc.,

Late Professor of Geology in King's College, London,

WHO WERE THE FIRST TO GIVE A PRACTICAL IMPULSE TO THE ARDENT DESIRE WHICH I ALREADY ENTERTAINED FOR THE STUDY OF GEOLOGY, ESPECIALLY IN ITALY, SO RICH IN MINERAL WEALTH,

This Small Volume,

AS A TOKEN OF GRATITUDE, ESTEEM, AND ADMIRATION,

IS RESPECTFULLY INSCRIBED

BY

THE AUTHOR.

Pisa, Italy, 1*st June*, 1867.

PREFACE.

In the fall of the year 1865, being deeply impressed with the important results that might be obtained for Italy by the development of her mineral riches, I undertook a geological tour through a large district of this fine country. In my explorations my attention was more particularly directed to Petroleum; and I became fully convinced of the very distinct indications which presented themselves in various places, more especially in the provinces of Modena and Reggio.

These indications appeared to me to be identical with those of America, and, in some spots, even much more favourable; in this opinion I am fully borne out by many scientific gentlemen who have lately visited those localities, and some of whom have published their ideas on the subject, *viz.*, Professors Stoppani, Canestrini, Manzini, Calegari, &c., &c.

We know from the testimony of the most ancient writers that Petroleum has been known to exist in the spots I have indicated from time immemorial. Herodotus, Pliny, Spallanzani, Valisneri, Humboldt, &c., &c., &c., all speak of the Salse of Querzuola and of Sassuolo, and bear testimony to the fact of oil being collected by the peasantry from the surface of the oil springs for household purposes.

In considering the enormous revenue obtained in

America from this precious material, and the almost fabulous fortunes made by private individuals thereby in an incredibly short space of time, I have been led to believe most sincerely that the like splendid results would be obtained in Italy, were it possible to induce either the Italians themselves or foreign capitalists to engage in an enterprise which offers such fair hopes of a successful issue.

I have explored the Petroleum zones in that stretch of country which extends from the south of Milan to the south of Bologna, and along the confines of Modena commencing at Pavullo, and in several places I have detected the undoubted presence of Petroleum; and in those spots more particularly described in this work, the indications are very strong.

On the ascending or northern slope of Monte Gibbio, where there is a gas-spring, on Monte Baranzone, and on other mountains, I detached pieces of the sandstone of which they are chiefly composed, and I found them to be strongly impregnated with oil; and even now, after preserving them for nearly two years, exposed to the action of the air, these pieces, when broken, give forth a very strong smell of Petroleum.

I have studied this subject for two years, I have devoted time, money, and the little talents I possess to it, I have travelled over mountains and valleys at all hours, and under very difficult circumstances in the prosecution of this inquiry; and I may now say with

a clear conscience, that I firmly believe in the feasibility of developing the Petroleum question in Italy, and that it will yet turn out to be the most fruitful source of revenue to this country that was ever yet conceived, and that the fortunate individuals who first enter the field will be rewarded beyond their most sanguine hopes.

Should this little volume (which pretends to no literary or scientific merit) be the means of drawing the attention of capitalists to the subject of which it treats, and thereby benefit a country which I love, in common with all well wishers of free and united Italy and her heroic King, I shall consider the labours that I have hitherto undergone amply repaid.

PISA, ITALY, 1*st June*, 1867.

A TREATISE

ON THE

PETROLEUM ZONES OF ITALY.

THE Modenese Apennines are formed, for the most part, of a sombre kind of sandstone, called by the Tuscans *Macigno* or *Pietra Serena*. Of this rock there are two kinds, that which contains large grains of quartz, and the other in which the atoms of quartz are so small as to be imperceptible to the naked eye. Both kinds contain extremely small scales of argentine or shining mica. The strata are not in all cases intimately attached, but are frequently slightly separated from each other by the interposition of thin layers of earth and, in some cases, of other sorts of stone. There are also to be met with in various parts, large masses of calcareous limestone incorporated in most instances with the sandstone, both of which are supposed to have been formed about the same time. Granite is more rare than the limestone, but may be met with occasionally.

Barigazzo has been noted for ages for the gas which emanates from a part of the mountains looking to the south. This gas burns spontaneously, but is sometimes extinguished by strong winds. Rain alone is not sufficient to put it out. It can, however, be readily lighted again with a match. There are small pools

here and there of a muddy-looking kind of water with air-bubbles floating on the top, and which are constantly rising up to the surface through the fissures in the rocks beneath. By collecting these bubbles into a vessel and applying a lighted match to them, they immediately take fire and give out a smell similar to that of hydrogen gas. Experiments have been tried with this gas in other ways to ascertain the extent to which it might be found in the dry earth. Holes have been dug in the loose soil a few feet in depth and then filled with water. The bubbles have immediately sprung up, and a light being applied to them, they have burst forth into a bright flame. The earth out of which this gas issues is evidently composed of pulverized particles of the *Pietra Serena* intermixed with small grains of quartz and the thin scales of mica already mentioned, together with a species of argillaceous limestone, the whole having been evidently washed down by heavy rains from the mountains above. At the surface this soil is of a dark colour, and has no doubt undergone a change by fire; at a certain depth, however, it is of an ash colour, and does not seem to have suffered in the least. Boulders of sandstone are found here and there superficially. Those of any thickness have, by the action of heat, been changed to a reddish hue to a certain depth, while the centre has preserved the natural colour of the *Pietra Serena*, whereas thin blocks have been burnt right through. The parts which have thus been burnt are extremely friable, which is not the case with the other portions. The cause of the surface of the soil only being changed by the action of heat, is explained by the fact that the hydrogen gas takes fire solely on coming into contact with the air.

The amount of caloric contained in the flames produced by the ignition of the gas is very great. Green branches of trees have been placed over them, and these branches have burnt as furiously as if they had been laid on a large fire, being reduced to ashes in a few minutes. While this gas is burning the smell of it is perceptible at the distance of more than 20 yards. The flames generally rise, at the most, only a few feet above the surface, but, on digging down to a slight depth, they rise much higher and increase in volume and intensity. They produce scarcely any smoke, and, by holding a white object over them, at a sufficient distance to prevent its burning, it remains untarnished. Another experiment has been tried, and it is this. A mound of stones and earth has been formed upon a portion of the ground where the flames were issuing out, for the purpose of seeing whether by this means they could be extinguished; they have remained inert for a short time, but gaining strength by their confinement, they have burst forth through all obstacles with greater vehemence than ever. Another experiment was tried with one of the small pools. The muddy water (silt) was emptied out and the gas was seen to bubble up as on the dry ground; on applying a light to this gas it immediately took fire. The pool was then filled with water and a small channel made leading from the same, so as to allow the water to run out in a narrow stream. A light having been applied thereto, the singular phenomenon of a river on fire (in miniature) was presented to the eyes of the spectators. It continued to burn as long as the water was allowed to flow out. These experiments have been made in the day time. At night the effect would be of course much more striking. A pit was afterwards dug in

the side of the mountain, at some distance lower down than where the gas was burning. This pit was about 16 feet deep and 6½ feet wide. At the bottom of the pit the earth was found to be black, wet, and muddy, and the smell of Petroleum was so strong as to be almost insupportable; there was, however, no perceptible heat in the interior. On throwing in a lighted match, the pit was at once filled with a bright flame giving out an intense heat. The flame was 8 feet high above the mouth of the pit, but it came not only from below, but also from the sides. It was observed, besides, that the flames which issued laterally, came out in a horizontal direction, and then arose perpendicularly, in order to escape from the pit, thus clearly showing that this inexhaustible supply of gas, which has been burning for ages, has its issues obliquely, at least near the surface, as well as from below upwards. On this occasion the smell of the gas was perceptible at about 70 yards and the heat at 12, whilst at 2 yards distance the heat from the flame could not be borne. The ground immediately around the pit, however, was only very slightly heated. The crackling noise made by the flame, in the mean time, was similar to that produced by the burning of dried branches. Some pieces of limestone, which were in the pit, were burnt and fell into fragments.

The flames which issued from the pit were different from those which issued from the surface of the ground in this, that they blackened the earth and stones which they touched. This blackened earth, which was found to be completely saturated with hydrogen gas, was placed on red hot coals. At first the smell of the gas was very acute, but this smell soon after disappeared, the water gradually evapo-

rated, the earthy portion which remained became of a greyish colour, but gave out no flame, nor any odour of bitumen or sulphur.

By placing the hand over one of the fissures in the earth, something like a light breath of wind is felt coming out. This is the gas, which, though invisible, can be felt. Some of this invisible fluid has been collected in a bladder with a brass tube, a light has then been applied to the orifice of the tube, and the gas has immediately ignited, sending forth a steady bright flame, which continued to burn as long as there was any gas left in the bladder. It has been ascertained that the gas issuing from the interior of these mountains is of the same temperature as the surrounding air. Seeing that the caloric of the flames which issued from the pit before mentioned was very great, it was thought that this heat might be turned to account for a practical purpose. It was therefore determined to erect a small lime-kiln on the spot, and in such a manner that the flames would pass through the stones. This was done, and succeeded admirably, the lime produced being of the very best quality. It was found also that, although heavy rain was insufficient to put out the flames, a large quantity of water thrown on them at once had the desired effect. This object was gained by filling a number of pails with water, and dashing the contents simultaneously on the flames, which by this means were extinguished. They were easily set on fire again by the application of a lighted match.

At no great distance from Barigazzo, to the east, there is a small rivulet which goes by the name of *Orto dell'Inferno*. This rivulet, however, is dry for the greater part of the year, and even in wet weather

the volume of water in it is not great. When the bed of this stream (which runs between precipitous rocks of the usual *Pietra Serena*) is dried up, it easily takes fire on a light being applied to it. In some parts of the bed where *silt* oozes out, the smell of the gas is very strong. This *silt* gathers into the hollows of the channel; and on immerging a large funnel into the turbid liquid so as to allow the gas to issue from the top, and a light being applied, a bright flame has immediately burst forth, about a foot in height. The nature of this flame in colour and appearance, and in the strong smell which emanated from it, corresponded exactly with the flames already described as issuing from the ground to the south of Barigazzo. On digging into the earth, the same appearances were also manifested as at the south, *viz.* the blackness of the soil, the dampness from *silt*, and the strong smell of the gas.

There is another place, called *Sponda del Gatto*, at a short distance from Sestola, where lights, similar to those at Barigazzo, have been observed from time immemorial to issue from the earth. Near Frassinaro the same sort of lights are observed, with all the accompanying indications of *silt* and the strong smell of gas, as already described.

At another place, three miles from Fanano, called *Serra dei Grilli*, there is a very extensive emanation of gas, which, on the application of a lighted match, takes fire, and spreads over a considerable area. The flames rise only about 1½ ft. above the surface.

I now come to another part of the subject which relates exclusively to Petroleum. There are small hills or cones both in Modena and Reggio, which some have supposed to have been produced by volcanic

action. These cones are masses of earth rising up here and there on the plain, and from the centre of which a semifluid mud is discharged, which runs down over the sides, enlarging the cones and forming small rivulets around. This liquid, as well as the cone itself, is called *Salsa.* One of these cones, at about the distance of fifteen miles from Modena, is called *Salsa della Maina.* This cone lies in a small plain about three hundred feet in circumference. The cone itself is about twelve feet in height, and the circumference at the base about eighty feet. The top is flat, and in the centre is a small crater, from which the liquid mud or *salsa* bubbles up, and flows down over the exterior. The *salsa* is forced up from the interior by hydro-carbon gas, which upon being set fire to, immediately sends forth a brilliant flame, giving out at the same time a very strong smell of Petroleum.

In the province of Reggio there are several cones in activity, continually ejecting large quantities of hydrocarbon gas, naphtha, and petroleum oil. The site of these cones is called the *Salsa di Querzola,* and is situated on the road between the town of Reggio and Carpinetti, being about nine miles from the former. This celebrated *salsa* is of great antiquity, and has been referred to by various writers both ancient and modern, amongst whom we may cite Pliny, Herodotus, and Humboldt. On exposing the liquid mud which issues from these cones to the action of the air, it leaves, on evaporation, a tenacious paste. The hydrocarbon gas, on being ignited, sends forth a bright flame, larger in volume and greater in height than that obtained from the cones at the *Salsa della Maîna.* The cones, of which there are six principal ones, in an extent of about one-and-a-half English acres, do not

differ in the least from each other in their main characteristics. The temperature of the issuing mud is 64° Fah. Throughout the whole of the hills in this part of the country there are unmistakable geological signs of the existence of Petroleum deposits; but the *Salsa di Querzola* is evidently the nucleus of the whole of the Petroleum existing in this portion of the Apennine range, as all the surrounding strata seem to dip to this spot, where the general reservoir or basin, fed by innumerable springs from every direction, finds its outlet.

Professor D. T. Ansted, M.A., F.R.S., in a Report delivered before the Royal Institution of Great Britain in May, 1866, on the subject of "The Mud Volcanoes of Europe," says:—

"In the mud volcanoes of the Crimea and the well-
"known and remarkable examples of Sassuolo and
"elsewhere (Querzola is the other), on the northern
"slopes of the Apennines, in the provinces of Modena
"and Parma, and in all others that have been minutely
"described by competent authorities, it appears that
"mineral oil (either naphtha or Petroleum) either issues
"with the muddy stream that forms the erupting
"matter (which is commonly the case), or comes out
"in quantity from springs or wells immediately adja-
"cent. Thus at Baku, and at other points across the
"Caspian, the quantity of naphtha obtained from springs
"near the mud volcanoes is enormously great, and has
"continued to flow from time immemorial. The number
"of wells is too great to be estimated. In one instance,
"I noticed a well, yielding a considerable quantity of
"naphtha, sunk within less than a dozen yards from
"erupting mud, and on the very slope of an extinct
"cone.

"It is not difficult to understand that while the "slow distillation at a low heat, capable of producing "mineral oil, may be most consistent with salses and "mud volcanoes, it is, at any rate, certain that Petro- "leum or bitumen is always associated with such slow "volcanic action as exhibited in mud volcanoes."

Of the volcanic force which has been applied with more or less regularity in the different parts of Northern Italy, very distinct traces remain, and in all those places hydro-carbon, bitumen, and Petroleum, may be found either separately or in combination with each other, or with other substances. This volcanic action has caused the liberation of the gases, which naturally sought their way up to the surface. In their passage, the slow distillation of the organic matter was a necessary consequence; and from this distillation it is by some supposed that Petroleum has had its source, appearing in the form of oil springs, or, in some cases, being retained in the solid substance of bituminous rocks.

To persons who have not closely studied the subject, it is a matter of great difficulty to know the best spots to bore for the oil, so as to come upon the principal deposit. The most attentive observation, together with a tolerable knowledge of geology, will alone enable any one to understand the various changes and conformations of rocks and soils, as regards the proper sites for undertaking operations, so as to obtain the largest quantity of Petroleum.

Perhaps no spot in Italy is so rich in Pertroleum deposits as the *Salsa di Querzola*, and it would require only a small amount of capital and some energy to convert it into a most profitable commercial undertaking.

It is to be regretted that no borings have yet been

made to obtain the Petroleum in very large quantities, so as to preclude the necessity of importing such an immense amount of this oil from America, but even by simple infiltration from the rocks composing the Northern range of the Apennines alone the quantity of Petroleum obtained has been by no means insignificant. This infiltration has been going on for ages, as attested by the ancient writers already mentioned, as well as in later times by Humbolt, Valisneri, Spallanzani, and several others. There are wells at *Monte* Bonello which have produced eleven tons of crude oil per diem. The greatest depth of these wells is one hundred and sixty feet. This oil in its crude state is used by the inhabitants of that part of the country as a light, and all the towns in the vicinity are illuminated with it, even Genoa and other large cities, previous to the introduction of gas, were lighted by native Petroleum in its crude state.

The "Salsa of Sassuolo" has been mentioned by various authors in different ages, and under various aspects. Frassoni and Ramazzini have described it as if it were an immense volcano in a state of activity, whereas contemporary writers and others who have come after them, have painted it in its true colours. Pliny's account of it, which is very *circumstantial*, is, however, in many parts highly exaggerated. All the writers, nevertheless, who have noticed this famous *salsa* have agreed as to the great quantity of liquid mud which issues from the mouths of the different cones, carrying with it Petroleum of a dark colour and very strong odour. The principal cone is about one mile from the town of Sassuolo, but there are various other cones surrounding the large one and at various distances; they all discharge the black liquid

mud already mentioned, together with large quantities of dark-coloured Petroleum. On applying a lighted match, as in the instances already mentioned, to the liquid mud issuing from the mouth of the superior cone, a flame is instantly produced. Close to this cone it was attempted to dig a pit, but the men employed were unable to penetrate very deep on account of the extreme tenacity of the clay, which it was impossible to detach with the spades. In fact, the earth for a great extent all round is composed of the same argillaceous clay, saturated with petroleum and hydrocarbon gas. Many irruptions of this black mud have taken place, raising up new cones and displacing old ones. On one occasion, when a rather strong eruption took place, a stream of muddy Petroleum was formed which extended half-a-mile. These irruptions are preceded by a dull subterraneous noise, and the ground slightly trembles until the gas has discharged the liquid mud, which it sometimes shoots up to a considerable height above the apex of the cone. Some of the streams, which this mud forms, have been found to be seven feet in depth near the base of the cone, and the current produced by the irruption frequently continues to flow for two days without interruption.

The *Salsa di Sassuolo* is much more extensive than that of Maîna, and contains besides a much larger quantity of gas; the force of which is also greater, and seems to be more concentrated. On the whole of the space occupied by the cones (about three quarters of a mile in circumference) there is no sign of vegetation, on account of the muriate of soda with which the earth is impregnated, and the nature of the earth being also argillaceous. This place has been carefully examined for the purpose of ascertaining whether there

are any signs of the action of volcanic fire; but all the indications have clearly demonstrated that no such action has ever taken place. Pieces of limestone have been ejected from the cones themselves, and they seem to be intact. The argil itself, which so easily hardens and takes a reddish colour on coming into contact with fire, has undergone no change. There is no lava, no ashes; so that it is wrong to suppose that these cones were ever volcanoes properly so called. It may be said that substances have been fused or calcined and afterwards buried in the old irruptions by the new ones. But, although every new irruption, it is true, causes an elevation of the earth, these elevations are not durable, as in the case of volcanoes, being frequently washed away by the heavy rains which fall in these parts. The mere fact, besides, of no volcanic body having ever been found on the spot or in the neighbourhood, is sufficient to settle the question as to these cones being the remains of extinct volcanoes.

At the distance of about half-a-mile from the *Salsa di Sassuolo* are the Petroleum wells of Monte Gibbio. These wells are sunk in a soft kind of sandstone at the bottom of a valley. The water which infiltrates into these wells is about a foot in depth, and the Petroleum floats on the top.

Referring again to the *Salsa di Querzuola*, I may state that it was anciently supposed that the mounds of which it is composed were nothing but volcanoes, and the accounts given by some of the old writers on the subject of these cones, border on the marvellous. They are described as vomiting forth fire, flames, smoke, and earth in large quantities, and even shooting up heavy stones into the air. It is evident that these accounts are greatly exaggerated, indeed, it has been

proved that they have no better foundation than the very unreliable reports of the peasants, who formerly regarded not only the *Salsa di Querzuola*, but all similar phenomena, with superstitious awe, as may be understood from the names which have been applied to some of those places, as *Orto dell' Inferno*, &c., &c.

Volcanic action has no doubt played its part in the upheaval of the mountains as in other parts of the country, but it is quite clear that the *salse* of which we are treating differ very much from the matters ejected from active volcanoes. The whole of the cones forming the *Salsa di Querzuola* are very numerous, and are situated on the side of a sloping declivity. They are somewhat of a sugar-loaf shape, the summits however, being flat. The opening or mouth is on the top in the form of an inverted funnel, and from this opening the liquid mud is being continually ejected by the force of the hydro-carbon gas, and running down the sides of the mounds, forms small streams which are to be seen on all sides slowly descending the declivity. In some of the conical masses the gas merely raises the mud to the height of the mouth whence it flows over, whereas in others the mud is shot up to a height above the apex of three, four, and five feet, and every irruption of this kind is accompanied by a slight noise which is heard at some distance. This noise is caused by the escape of the gas, which is easily seen by approaching the mouth of the cone. By applying a lighted match to the gas bubbles as they burst, a flame is produced, thus proving it to be hydro-carbon gas. The largest of these conical mounds is about twenty feet in circumference at the base, and about seven feet in height. There are also several pools containing a turbid

looking water with Petroleum floating on the surface. It would be useless to give an exact description of the several cones, their size, position, &c., because they are continually changing their form and site, partly in consequence of the action of the atmosphere, and partly in consequence of the alterations produced by the irruptions. But their general characteristics remain the same as to the matters ejected and the quantities thereof. The way in which these cones are formed is very curious. On a part of the level ground which seems to be perfectly dry, a damp circular spot makes its appearance, in the centre of which there is a small opening. From this opening issue the gas-bubbles forcing up the liquid mud, which flows over all round and gradually takes the form of a cone with the inverted funnel-like mouth as already described. As this operation progresses, the cone daily becomes larger until it reaches its maximum height and breadth. This is the way in which the conical mounds called *Salse* are formed.

The quantity of gas, Petroleum, and other matters ejected from these *Salse* is, as already stated, very great. An attempt has been made to collect the gas in bladders from the larger cones, and the quantity obtained in this way in *one minute* was four hundred and twenty-four cubic inches, although of course a larger quantity might be secured by a more perfect method of collecting it.

It must be observed that the gas does not issue from the aperture in a continuous stream, but rather in puffs. A cone, for instance, having ejected its gas for three or four minutes without interruption, will suddenly cease for eight or nine seconds, and then recommence as before, and so on. It has been ascer-

tained that in this interval of repose the current of gas is positively and entirely interrupted, for, on lighting the bubble on its bursting, it has continued to burn as long as the gas continued to flow, but immediately that it ceased, the light was extinguished. A continuous flame, however, has been obtained in the following way: the apertures of the smaller cones have been all stopped up with large quantities of earth trampled into them, and the gas was thus forced, by means of the subterranean communications between the different cones, to take the direction of the large cone, which was the only outlet left for its exit. The volume of gas which by this means was made to issue from the mouth of the large cone was very great and uninterrupted. A lighted match being applied to it, a large flame of a bluish red colour was at once obtained, which continued to burn for a long time without any interruption. It was extinguished, however, without much difficulty.

Now this experiment would lead one to the conclusion that the proper mode to obtain Petroleum, which abounds so plentifully in these conical mounds, would be to sink a well near the site of the large cone, and to close up the mouths of the other cones with brick or stone work. By this means the smaller outlets being cut off, and a sufficiently large outlet being established at one point for the escape of the whole of the gas, it is natural to suppose that all the precious material would be collected into the said well.

The hydro-carbon gas of these *Salse* is united, it would seem, with a portion of carbonic acid gas, which accounts for the facility with which the flame is extinguished.

As before observed in speaking of other *Salse*, the

irruptions of gas and liquid mud produce no signs of smoke. Even when the gas is lighted the smoke which it emits (if any) is not perceptible.

It is to be remarked also that rains, however heavy, or winds have no effect on the irruptions, which continue to go on as in fine weather, although it is thought by some that rain produces a larger flow of the liquid mud.

Although the mouths of the cones are comparatively wide, they are not more than a few feet in depth, and a pointed stake cannot be driven into the tenaceous argillaceous clay of which the cones are composed more than four or five feet.

The muddy water which issues from these mounds (which seems to boil, although in reality its temperature is about the same as that of the air) is very salt, and, by boiling the water, it is found that this salt is Muriate of soda. In all cases the Petroleum is constantly found floating on the surface of the water.

It sometimes happens, though rarely, that extraordinary irruptions take place from these mounds. On these occasions the earth trembles, the underground rumbling noise becomes very loud, the liquid mud in the apertures of the cones is greatly agitated, and at last the imprisoned gas, forcing its way upwards with irresistible fury, shoots mud, water, and stones into the air to a great height. This continues sometimes for two days uninterruptedly, until the gas, having cleared for itself a sufficient passage, gradually resumes its ordinary course.

By sinking a well, or boring deeply into the ground, so as to secure a free passage for the hydro-carbon gas, these extraordinary irruptions would be of course prevented.

All observers have agreed in stating that this powerful gas has its origin, not only at the *Salsa di Querzuola*, but at that of *Sassuolo* and others, in Petroleum, because this oil, as we have already remarked, is seen floating on the muddy water, and wherever, in the neighbourhood, there are stagnant pools, it is found in large quantities on the surface, and the smell of it is perceptible at a great distance.

The soil of the *Salsa di Querzuola*, as well as that of *Maina* and *Sassuola*, is argillaceous, as is also the mud, which the cones have been ejecting for ages. These three *Salse*, moreover, resemble each other in this: that, besides the earth and the water which issue from it being salt, the salt is muriate of soda; and in all these, the earth, the water, and the salt, are strongly impregnated with Petroleum. With these cones, therefore, the three substances—argil, salt, and Petroleum —are intimately connected; in fact, they would seem to be inseparable from them.

If it be true that the hydro-carbon gas is an emanation from Petroleum, what must be the quantity of that oil deposited beneath the spots we have indicated, when we consider the unknown ages during which the gas in question has been issuing from the places described?

As I have already stated, Petroleum is not a new discovery in Italy. It has been known to exist for ages, especially in the provinces of Modena and Parma. The peasantry have used it as a light from time immemorial, and more than sixty years ago the city of Genoa was illuminated with this oil. Yet, strange to say, no attempts have been made, up to the present time, to obtain it in large quantities by the aid of machinery, as in America. The peasants collect it as it floats on

the top of the water contained in small pools. By infiltration, through the sandy strata of the Apennines, the Petroleum undergoes a natural kind of distillation, and is produced in this way most wonderfully pure. Wells of no great depth have been sunk, it is true, by a few proprietors, on their private estates in different parts of the Petroleum producing districts of Italy, but, through an apathy which it is almost impossible to understand, these wells have been allowed to choke up and go to ruin. In no case, I believe, have they been constructed with any amount of care, so as to prevent the soft sandy clay from being washed into them by the mountain torrents in the rainy seasons; not even a simple parapet around the mouths of the wells. The mode of collecting the oil, too, from these wells, was very primitive. An iron bucket, attached to a long rope, was let down, and the oil allowed to pour into it until filled, then the bucket was drawn up, and the same operation performed, until the whole of the oil floating on the water at the bottom of the well was exhausted.

It is recorded that one of these wells produced five tons of oil in a month, but on accouot of the careless way in which it was constructed, the sides fell in, and the work was abandoned. In another well which was being sunk, there was very little evidence of Petroleum, and the owner was on the point of giving up the affair, when a fissure in the side, not far from the surface, suddenly opened, and the oil poured out in large quantities. This stream evidently came from a deposit in the vicinity, but no steps were taken to find it out.

Strangers have been invited of late to form companies for the purpose of working the spots where

there are good grounds for believing that Petroleum exists in large quantities; but they say, and with some appearance of reason, if Petroleum is to be had so plentifully by boring for it, why do not the Italians themselves form those companies? It is not for me to say one word against a people in whom I have found, after a residence of two years, so many great and noble qualities to admire. There are many causes to which the apathy of the Italians to industrial pursuits may be attributed, and their insensibility to the mineral riches of the soil of their highly endowed country is to be found, not in ignorance of the great advantages to be derived therefrom, not in the want of means or inclination in their capitalists, but in the unsettled state of the nation after a political revolution, which, by its splendid results, has dazzled their imaginations, and left them, if I may be allowed the expression, no breathing time to turn their widely acknowledged talents to the practical development of the country through industrial pursuits. But I venture to prophesy that the time is not far distant when the Italians (their political controversies being set at rest, and their finances placed on a firm basis) will turn their attention seriously to the mineral riches contained in the bowels of their now unproductive mountains. There is no reason whatever to suppose that Italy will not shortly be as celebrated for her industry in agriculture and in mineral pursuits as she has always been in the arts and sciences. That she is now far behind the other civilized nations of Europe in those branches of industry, her sons themselves confess, and this is a sign of a determination to improve—to progress. One of the richest products of Italy is sulphur, and yet what does one of the most

learned of the Italian geologists, Professor A. Stoppani, writing on "Petroleum in Italy," say with regard to this precious article of commerce? "To think," says he, "that half of Italy may be considered as an im-"mense sulphur mine, and that we still receive our "sulphuric acid from other countries, is truly shame-"ful." On the same subject the learned geologist quotes the sentence pronounced by the International Commission of the Great Exhibition of London of 1861, to the effect that Sicily had exhibited extremely rich samples of sulphur and other mineral products; the members of the Jury, however, were not ignorant that, although some improvement had taken place in the industry of the country, it was still in a very bad state. The method also of preparing the sulphur for the market was so inefficient, that fully one-third of the article was lost! The Jury was therefore of opinion, that the fact of nature having placed an inexhaustible mine of sulphur in the Sicilian soil did not reflect any merit on the inhabitants, and that, from the defective manner of collecting and preparing the material for commerce, entitled them rather to blame than to praise. The Jury consequently thought that the best thing that could be done, in order to induce the Italians to use their efforts in developing the mineral riches of their country, was not to grant them either premium or honourable mention, rewards which should be only accorded to industry and skill.

If the Italians, therefore, have been so backward in the matter of sulphur, is it any wonder that they should be hitherto so apathetic as regards other mineral products, Petroleum, for instance?

The internal riches contained in the Italian soil

are unknown; they can be only in part guessed at, because no explorations of sufficient extent have been made. Fossil coal, for instance, is found on the surface, but then, they say that it is only to be met with in isolated lumps. Who knows? Have borings been made to a sufficient depth, and in a sufficient number of sites? Certainly not. Until that is done, however, no person has a right to say that coal-beds are not to be found in Italy, sufficient in extent to be worked as a commercial enterprise, or to obviate the necessity of importing so expensive an article, and so indispensable for the preparation of many of the minerals for the market. This is, in fact, the excuse of many Italians when accused of their want of energy in works of industry, "We have no coal." But it has been asserted by many geologists that coal actually exists, of good quality and in large quantities, and moreover they have pointed out the places where it ought to be looked for.

Petroleum, however, is an article that does not require the aid of coal (or at all events in very small quantities) for its development, nor is complicated or expensive machinery a *sine qua non* for its production. The Italian Petroleum, in its crude state, is limpid and pure, and requires merely to be separated from the water (an easy operation) to render it fit for the market.

Signor Stoppani, already referred to, and who has written a very able pamphlet on the Italian Petroleum, complains that, notwithstanding the immense amount of sulphur in the country, sulphuric acid continues to be brought from other countries.

This distinguished geologist does not desire to join with those who endeavour to run down his countrymen

in the opinion of themselves and strangers, and I perfectly agree with him. It is the duty of all those who are interested in the future of this fine country, to encourage, and not to upbraid; to hope, and not to despond. It is for this reason that Signor Stoppani makes no mention (if I am not mistaken) of the immense quanties of American Petroleum which is consumed in Italy, while this country, as is now well known, is as rich in Petroleum of the best kind as it is in sulphur. It is needless to say that a country which is almost entirely dependent on foreign nations for the most necessary articles of daily life, that a country which is wanting in manufactures, in a good system of agriculture, in the enterprise which is necessary to develop the mineral riches of the land, such a country so unfortunately placed, it is needless to say, I repeat, cannot prosper to that extent which all well-wishers desire for Italy.

I have already said, on the authority of ancient, as well as of modern writers, that Petroleum in Italy is as old as the hills. It has been used not only by the peasants in their household economy, but cities have been illuminated with it before the introduction of gas; yet as an article of commerce it has been totally neglected, and, in this sense, might as well have been altogether unknown. In some places the *salse* have been regarded as curious phenomena by the learned, and have been looked upon with superstitious awe by the ignorant. It is only within the last few years that the general attention has been turned to this source of wealth contained in the Italian soil, more especially after the astounding discoveries made in America. When we read and hear of wells in Pennsylvania producing from 2,000 to 3,000 barrels of Petro-

leum in one day; when we know of men in the lowest scale of society who, in a few weeks, by the discovery of Petroleum, have become millionaires; when we see before us irrefragible proofs of beggars suddenly becoming the possessors of fabulous sums of money, we pause to take breath. So much for individuals. But what effect must such a wonderful discovery and the prompt use that has been made of it have had on the prosperity of the country itself? What employment for the unemployed multitude! What an increase in the daily comforts and necessaries of life, and in the consequent circulation of capital! What a means for the intellectual improvement of the people in education and in enjoyment! And above all what a facility it has afforded to the poorer classes to pay the necessary high taxes imposed by the government after a civil war, for the magnitude and destructiveness of which the history of the world offers no parallel! The United States of America, in fact, in a few short years of intestine strife, incurred a debt which, for its amount and the rapidity with which it accumulated, was the wonder of the slow-going nations of the old world. But this wonder has been almost effaced by another wonder immeasurably greater. It was said, and with some appearance of reason, that this immense debt would crush the energies of the American people, just after such a tremendous struggle, and when the country was still in a state of disorganization almost amounting to anarchy. But no! The Americans now laugh at the debt; they boast of it as much as of their prowess and skill in the war that occasioned it; nay more, for they have exhibited a far greater amount of moderation and modesty than could have been expected, and the last exposition of the financial

state of the country has shown a surplus over the expenses of several millions! In a few years there is no doubt that this debt, which would for ever ruin any other country less energetic, will be entirely paid off. I think I am not far wrong in attributing this happy result, in part at least, to the use which has been made of the discovery of Petroleum. Yet, in Italy, although Petroleum has been known to exist for ages, no practical use, on a large scale, has been made of it. Its nature has not been understood, except by a few, and many have even denied its existence altogether! It is at present, however, generally acknowledged that Petroleum *does* exist in Italy; in fact, there is no longer any doubt expressed about it; but the question is, whether it can be obtained in sufficient quantities to justify the outlay of capital in making the necessary explorations and borings. The superficial explorations have been already made, and the spots in which Petroleum is most likely to be found in large quantities marked on maps especially prepared for that purpose. I cannot, of course, promise that a desposit such as that I have spoken of as existing in Pennsylvania, yielding up to 3,000 barrels a day, will be met with, but that reservoirs of Petroleum do exist in Querzuola, Sassuolo, Monte Bazzano, Monte Gibbio, Monte Barranzone, &c., or in their immediate vicinity, I have not the slightest doubt, and in this opinion I am borne out by the most distinguished geologists of Europe. It is thought by some people that the wonderful deposits discoversd in America have been merely acci dental, and that the wells were naturally formed and ready made for those fortunate individuals who might find them; but I need hardly say that whoever entertains this idea is very much mistaken. The discovery

of the first traces of oil floating on water was, of course, accidental, but the boring of the wells to get at the deposits was another affair. The indications, both geological and otherwise, of the existence of Petroleum deposits in the places above mentioned are more strongly marked than they have been in any of those localities in America where oil has been struck. The Americans, on first ascertaining that oil *might* be found in considerable quantities by digging for it, did not hesitate, but immediately set about the work. They said to themselves, "If the mountain will not come to "us, we will go to the mountain." Or, in other words, "If the Petroleum, of itself, will not flow out to us "from the bowels of the earth in rivers and lakes (which "is not to be expected) we must bore down to where "it is, open a way for it, and thus bring it to *light*." Oil has not yet been struck in any considerable quantity in Italy, for the reason that no borings have been made, and there is no doubt that the first parties in the field will be the greatest gainers, and it is with this view that I have secured the greatest extent possible of those spots which give the truest indications of oil deposits. There is a great amount of apathy for the moment shown with regard to Petroleum in Italy, but, when the first properly-conducted boring succeeds, there will, no doubt, be a rush as there was in America. But even supposing that, by boring to a certain depth, large deposits of oil are not found, which is held to be improbable, the working of the *Salse* alone by proper machinery in producing oil, soap, bitumen, and other useful articles, can be shown to give more profit than any other commercial undertaking of the present day in Europe. Besides, in exploring into the depths of the earth, what mineral

riches of other kinds may not be discovered? Is it not probable that iron, lead, copper, and even coal may be come upon in sufficient quantities to more than repay the labour and money spent in the enterprise? Signor Stoppani, in his very clever pamphlet, says that the first traces of the vast deposits of Petroleum which has brought so much wealth to North America were discovered in springs. It was only when private enterprise opened up those springs to find out the deposits which fed them, that the Petroleum gushed forth in torrents from the bowels of the earth. He states his belief that these Petroleum springs, existing as they do in such large numbers in Italy, must also have immense deposits or reservoirs to feed them. But he adds, truly enough, that these deposits to be found must be sought for, and that the first step to be taken is to sink wells near the Petroleum springs or *Salse.*

The Italian Government has become so fully aware of the important discoveries made as to the extent of the Petroleum lands in Italy, that it has increased the import duties upon all foreign Petroleum from 20 to 60 francs per ton.

The following table of the imports of Petroleum, from the United States to the undernamed places alone, may not be uninteresting:—

	1861.	1862.	1863.	1864.	1865.	1866.*
To Marseilles . . .	1,600	135,765	1,167,893	1,982,075	1,145,895	1,178,714
„ Palermo . . .	—	3,990	57,115	79,830	500	56,580
„ Genoa & Leghorn	62	21,000	399,667	679,603	522,133	1,002,165
„ Trieste	—	—	3,000	165,175	66,371	—
Total . . .	1,662	160,755	1,627,675	2,906,683	1,734,899	2,237,459

* For the first three months only.

The eminent geologist before cited, Professor Stoppani, says in his report that the poor results obtained from the wells excavated by the proprietors of land in the Petroleum zones, are to be attributed, not to any want of deposits, but to the absence of technical knowledge in boring the wells, and in protecting them from the water and gas, to the want of proper machinery, and the necessary capital to carry out a rational system of works.

The following extract is taken from the Report of Professor C. F. Chandler, Ph. D., Professor of Analytical and Applied Chemistry in the School of Mines, Columbia College, New York, who analyzed some Italian Petroleum.

" While the Pennsylvania Oils contain on the " average 10 per cent. of gasolene, 10 per cent. of " naphtha, and only about 75 per cent. of illuminating " and lubricating oils, the Italian oils are remarkable " for the entire absence of gasolene, and in many " cases of naphtha, the yield of illuminating and lu- " bricating oil reaching from 88 to 97 per cent. This " is greatly to the advantage of the Italian oils, as " gasolene and naphtha being very low prices in the " market.

" The Italian Oils are also distinguished by the " absence of the offensive odour which characterizes " most of the American Petroleum. Not one of the " ten samples is disagreeable, while several of them " are almost odourless; a circumstance which will tend " to simplify the process of refining. The light colour " of most of the samples is equally striking.

" In the reports of the analyses, all the oils having " a density below 36° Baumé have been recorded as " lubricating oil; the skilful refiner has it in his power

" to convert a great part of this into lighter illumin-
" ating oil, by 'cracking' (redistilling very slowly)
" it, whenever the comparative market prices of the
" two oils make it profitable to do so. It must not
" be supposed, therefore, from the analyses, that the
" Italian Oils will not yield much illuminating oil, for,
" on the contrary, they possess a great advantage in
" their weight, which makes it possible to obtain from
" them an unusually large yield of either illuminating
" or lubricating oil at pleasure."

Professor D. T. Ansted also reports very favourably of the Italian Petroleum. In one place he states that in his presence, after a heavy rain, eight barrels (1,150 chilog.) of the oil were collected in the short space of two or three hours, and this only by permeation. He adds that 1,300 barrels (120,000 chilog.) were collected by the same means, in the same place, in the previous year, and that the quantity could probably be increased to 2,500 barrels or 300 tons by merely enlarging the basin so as to contain the whole of the oil which is washed down with the water. He further states that he is quite convinced that by boring to the depth of about 100 yards a large quantity of light oil would be reached which would probably flow up to the surface.

It appears from a lecture delivered by Professor Paolo Terrachini, a short time ago, that some springs, rich in Petroleum, on the sides of Montegibbio, near Sassuolo, still go by the name of baths, having been anciently used for that purpose, in a medical sense, for the cure of skin disenses, which in those times were more prevalent than they are now. This distinguished professor states that Montegibbio must be reckoned amongst the richest of the many Petroleum zones

which are now known to exist in Italy. From this eminence, he says, the Petroleum oozes out mixed with water, upon the surface of which it floats, being lighter.

These springs, or *Salse*, were greatly esteemed by medical men and by naturalists.

Amongst others, the uncle of the famous poet Ludovico Ariosto, when he was Prœta of Castellarano, wrote a book in praise of these springs, which he dedicated to Duke Borso Estense, to whom he presented it. This was in 1462.

There is also a letter extant, written by he celebrated Professor Bernardino Ramazzini, describing the oil itself, which was obtained from the springs of Montegibbio and of Monfestino. He calls it a "divine remedy" for the leprosy, and all other skin diseases, and he speaks in nearly the same high terms even of the water and the mud of these springs.

Signor Stoppani, speaking of the famous Petroleum springs of Montegibbio, says that, considering the strong indications of oil, and the quantity that is obtained by simple permeation, it is wonderful that proper wells have not been sunk.

He states that this branch of industry has remained what it was as described by Ariosto four centuries ago. This professor brought away with him a portion of the oil from the springs, which he says is very clear, and of the colour of amber.

There is no doubt that if capitalists would undertake to develop the Petroleum of Italy with half the spirit and energy of American speculators, they would confer a lasting benefit on the country besides enriching themselves. An objection has been made to the American oil on account of its insufferable smell; the Italian oil, being much purer, has not such a strong

smell. There would be also a great advantage in Italy in the fact that the cost of labour is much less, and other expenses would be low in proportion. The quantity of Petroleum imported into Italy has been already referred to; were proper borings made there is no doubt that a sufficient supply of this oil would be procured, not only for Italy, but also for the other countries of Europe and of Africa as well, into which it is brought from the United States, and at a much cheaper rate. It is an article which is daily becoming more useful, and a few years hence, when the prejudice which at present exists in some places against the use of it will be dissipated, the consumption will be very greatly increased.

Another great objection to the American Petroleum, besides its offensive smell, is the cost of transport. It is calculated that this item of the expenses from the oil regions to the shipping ports amounts to from 300 to 400 per cent. on the value of the oil at the wells; the freight from New York to England is generally about eight shillings per barrel; so that, altogether, the price of the oil in London is not far short of 700 per cent. on the original value of the oil. This is enormous. The consequence is that Petroleum, although not so dear as it was once, is still too dear for many purposes to which it could be applied. The Italian Petroleum, if properly developed, can be sold at a much lower rate than the American, and give at the same time great profits to speculators. Besides, to bring this oil into general use, it is necessary that it should be cheaper, for as soon as it can be sold at a less price than the present, the demand will be greatly increased, as it will be adopted for many uses from which its dearness now excludes it.

As I have already stated, one of the most important Petroleum zones in Italy is that in which Monte Gibbio is situated. Professor Stoppani, who has studied this spot in an especial manner, states that there were two little streams which issued from the declivity in this place, and which bore strong signs of Petroleum. These streams were quite muddy, and in one spot they formed a small pool, on the top of which floated the oil. He expresses surprise that proper wells have never been made in this place, as he considers that, by boring, large quantities of Petroleum would assuredly be found.

In a printed pamphlet by W. P. Jervis, F.G.S., on the "Mineral Resources of Central Italy," he states that Petroleum exists at Monte Gibbio in immediate contact with a lignite bed. Of some of the lignites of Italy he speaks in very high terms; he says that the tertiary lignite in Italy is the best in the world, and that the deposits of this valuable article ought to be turned to account at once, and become the source of industrial speculation. It is difficult to distinguish some of the Italian lignite from Newcastle coal, and Professor Cocchi considers it equal to it for every purpose, the more so as it produces excellent coke and abundance of gaseous matter; so that it is suited for a variety of uses, such as for metallurgical and gas works, and for steam-vessels. The French government have specified it among the varieties of coal allowed to be purchased for the Imperial Navy. Lignite has been employed at the arsenal of Genoa with success.

A great deal of lignite of good quality is known to exist in the province of Modena, and especially in the Petroleum zone.

Mr. Jervis states besides that, although the inferior qualities of lignite in Italy do not possess great caloric power, they often contain mineral oils which might be turned to good account by distillation, and return large profits. It need only be mentioned that at Halle, in Prussian Saxony, the manufacture of oil, paraffine, and the valuable series of tar dyes, from tertiary brown coal, has been carried on of late years with wonderful success, and is daily increasing. What an advantage it would be, says Mr. Jervis, if the lignite scattered through more than a dozen provinces of Italy should be employed in the manufacture of oil and candles, which might be as easily and extensively exported to Western Europe as those of Prussia. The Italian government, he continues to say, would do well to give every encouragement to the establishment of such manufactories in Italy, as the high prices at which the products of distillation are sold would permit them to form an important article of export.

I have stated that the large deposits of Petroleum in America which have made the fortunes of so many, and by which a new branch of industry has been opened up for that country, were discovered not by accident, but by boring deep into the earth. To show that, before these reservoirs were made to give up their treasures, the indications of Petroleum in the United States were much less strongly marked than they are in Italy, I think it well to give a few extracts from a Report written by Mr. J. S. Hays, Chairman of the Special Committee of the United States Revenue Commission, on Petroleum as a source of national wealth, and addressed to the Secretary of the Treasury.

Mr. Hays begins his report by stating that an

Act, approved in July, 1862, was passed to provide internal revenue to support the Government and to pay interest on the public debt, and a duty was imposed on coal illuminating oil, refined, produced by the distillation of coal, asphaltum, shale, peat, Petroleum, or rock oil, and all other bituminous substances used for like purposes, ten cents per gallon.

By the Act of June, 1864, the duty was raised to twenty cents. By the 8th section of the same Act, it was provided that a duty of one dollar should be paid on all *crude* or rock oil that might be produced and sold, or removed for consumption or sale.

This duty amounted to 1,003,522 dollars for *one district alone*, in Pennsylvania, for the *six months* ending December, 1865.

Mr. Hays, after citing several Acts regulating the duty on other oils, then goes on to give a short history of the American Petroleum, and his account of the original discovery of this precious liquid so closely resembles that of the Italian Petroleum, that I shall give it in as few words as possible.

" Petroleum, or rock oil, was known to and used
" by the Indians, who esteemed it highly as a medi-
" cine. That it had also been collected in large quan-
" tities by a race of people more advanced in civiliza-
" tion, who preceded the Indians upon this continent,
" is quite probable, from the testimony taken by the
" Commission. Upon Oil Creek, in Pennsylvania,
" remains of old wells or oil pits are still to be seen.
" Some of these pits were ten or twelve feet in dia-
" meter, and eight or ten feet deep, and the Indians
" had a tradition that they were dug by a people who
" lived before their race. So old were they that large
" oak trees had grown and decayed in them, but the

"oil had preserved their roots. When the pits were "first opened by white men, they were found to "be walled in by timbers, which were very well "jointed."

By the above extract taken from an Official document it would appear that Petroleum was collected ages ago in America by means of surface wells, as it has been and is to the present day in Italy. Indeed the report states further on that the rock oil had been obtained by the whites in the same manner, but only in small quantities, in New York, Pennsylvania, Virginia, and Kentucky. I consider that this fact is worthy of serious attention in showing the analogy between the American Petroleum and that of Italy. For centuries in the United States this precious oil was deemed to be a produce obtainable only at or near the surface. The same opinion has prevailed in Italy, and perhaps still prevails in the minds of many. It was not until the year 1859 that the idea of sinking a proper well for the purpose of obtaining the oil in larger quantities was first entertained. This happy idea was carried into effect by the Pennsylvania Rock Oil Company, who sunk an Artesian well in Titusville, in Venango Country, and it succeeded beyond their most sanguine expectations; oil was struck at a depth of 69 feet 6 inches from the surface.

Before this time, as I have already said, it was not known that Petroleum was to be found except near the surface, but as soon as the idea of seeking deeper for it was entertained a company was immediately formed, in the energetic style of the go-ahead Americans, and the result fully justified the boldness of the undertaking.

The American Petroleum, like that of Italy, was

at first sold by the druggists as a liniment and for other medicinal uses, under the names of Seneca oil, rock oil, American oil, &c. The mode of collecting it was by digging trenches or pits, and, by means of woollen cloths, gathering the oil which rose to the surface. Occasionally, parties boring for salt water, for the purpose of obtaining salt, were incommoded by the flow of a blackish substance, which proved to be crude Petroleum, and sweet water wells had been also spoiled from the same cause.

This is exactly what has frequently happened in Italy. Professor Stoppani, in his pamphlet on "The "Italian Petroleum," says that many of the sweet water wells have been spoiled by the flowing of Petroleum into them.

The circumstances which led directly to the extraordinary development of Petroleum in America are thus related:—In the year 1853, Mr. George H. Bissell, of New York, saw at the office of Professor Crosby, of Dartmouth College, a bottle of Petroleum, given him by Dr. Brewer, of Titusville, Pennsylvania, found upon his (Dr. Brewer's) land. Mr. Bissell became greatly interested in the product, and about six months after proceeded to Titusville with Mr. J. G. Eveleth, who was then, and had been previously, his partner in other business. They bought from Brewer, Watson, and Co., what were then thought to be the principal oil lands of Pennsylvania. They were in extent 100 acres in fee simple, and 112 acres on leave for ninety-nine years, for which lands they paid 5,000 dollars. Before purchasing they prospected the land, and dug holes into the ground 6 or 7 feet deep. The oil and water together percolated into these holes, and the oil was afterwards gathered by dipping woollen

cloths into the mixture, and wringing the cloths out. They did not prospect the oil for medicinal purposes, but they believed it would be a good illuminator, and they sought it as an article of commerce. Illuminating oil from coal was just beginning to be talked of, but very little was made then. They afterwards, in 1854, organized a company in New York city, under the name of the Pennsylvania Rock Oil Company. The nominal capital was 500,000 dollars.

This was the first Petroleum company, it would seem, that was ever organized in the United States, and fully bears out my remark on the energy displayed by the Americans in forming a company with so large a capital, for the purpose of working the Petroleum lands on a large scale, and thus opening up a new branch of industry to the nation. It is to be observed, too, that the indications of the oil in Pennsylvania were decidedly less strongly marked than in the Petroleum zones of Italy. In the former place the oil was obtained by digging pits in the ground, and then dipping woollen cloths into the liquid that oozed out, and by wringing the cloths, to squeeze out the oil. In Italy, on the contrary, the oil is skimmed off the surface of the water in buckets.

It has been observed that the oil-producing lands of Italy differ from those of America in this, that the Petroleum in the former is the effect of volcanic action. But I would ask, is not Petroleum the produce of volcanic action also in America, in the Crimea, in Persia, and in all other places where this bituminous oil is found? There are few parts of the world (if any) where volcanic action has not played its part in changing the face of the globe since its first formation. It is a generally acknowledged fact in geology, for in-

stance, that Scotland was at one time 2,000 feet below its present level, and other parts of the British Isles 1,300 feet, and that, therefore, the upheaval since then (the glacial period) has been to the same extent. At another period, it is shown that the British Islands were united to the Continent, and that the Thames was a tributary of the Rhine. The Great Desert of Sahara once lay under the sea. Sicily was once a part of Africa. The upheavals and subsidences in the American Continent have been very great; and during the earthquakes of 1811–12, in the valley of the Mississippi, very important changes took place in the features of the country. Many parts of America were 200 feet below their present level. Is not all this due to volcanic action?

Sir Charles Lyell says, in his work on 'The Antiquity of Man':—

"Little progress has been made in divining the "most probable causes of these great movements of "the earth's crust, yet what little we know of the "state of the interior leads us to expect that the "gradual expansion or contraction of large portions "of the solid crust may be the result of fluctuations "in temperature, with which the existence of hundreds "of active and thousands of extinct volcanoes is pro-"bably connected.

"After all, it is of little consequence, in a commer-"cial point of view, what may be the origin of Petro-"leum; it is enough to know that in Italy the indica-"tions of the oil are similar, only stronger, to those "in America, and consequently the deposits may be "safely assumed to be at least as extensive."

The Pennsylvania Rock Oil Company, above referred to, did not at first begin to sink wells; in fact,

it was not until 1859, five years after the company was formed, that they sank the first well, which succeeded so happily, as already explained. During those five years the work was carried on in a very primitive manner, as will appear by the following evidence, which was given before the United States' Commission :—

"We proceeded to develop these lands by trenching them, and raising the surface oil and water into vats. These trenches varied from 12 to 18 feet deep, 3 to 4 feet wide, and about 60 or 70 feet in length, and were dug so as to converge, increasing in depth, to a central point at a small saw-mill upon our land, where we collected the oil which had run from the different trenches to that point by a pump worked by the water-power connected with the mill. The supply was very limited, amounting to, perhaps, a few barrels in the course of a season, which we sold for $1,50 per gallon, to parties who sold it for medicinal purposes."

After detailing some further operations and analyses of the oil, the evidence continues :—

"The work of trenching the lands was continued until 1858, when we heard that Mr. Kier, of Pittsburg, had obtained a small quantity of oil from one of his salt-wells near Pittsburg, which oil somewhat resembled our own: these salt-wells were artesian wells. The Pennsylvania Rock Oil Company then determined to sink an artesian well." The result of this well has been already given.

The success obtained by the Pennsylvania Rock Oil Company in striking oil created a great excitement, and was, it may be said, the opening up of this great branch of industry in America.

A few months afterwards many wells had been

sunk: the oil fever had set in. The hotels were thronged, and crowds of speculators were seen constantly buying, then selling, then buying again, and so on; so that one plot of land would frequently go through the hands of a dozen different parties in a single day. Most of the wells worked well. The Crossley well yielded 35 or 40 barrels a-day. The Hoover well yielded 40 barrels a-day. In the month of June, 1860, the product of all the wells was about 200 barrels a-day. By January, 1861, it had increased to 750. This was still in only one portion of the oil-producing district of Pennsylvania. The production of the Kanawha region, West Virginia, had also become large, but was soon after lessened by the inroads of guerillas.

But up to this time the necessity of deep borings was not understood. In the spring and summer of 1861, however, borings were pushed through the first and second strata of sandstone, and, at depths varying from 400 to 500 feet, cavities were reached filled with oil and carburetted hydrogen gas. The water and oil were forced out by the gas to a great height, in some instances 60 or 70 feet above the surface, and the fortunate adventurers were in possession of what they call in America "flowing wells." Three of these wells yielded each over 2,000 barrels per day; these were, the Burnt Well on the Blood Farm, five miles above old city; the Philips Well, and the Empire Well. Large quantities of the oil was lost for want of facilities for preserving so great a produce, in fact people were not prepared for such overflowing torrents. Many other flowing wells were struck about this time, and a larger number of pumping wells were in activity.

The daily production for the year 1862 is estimated at 20,000 barrels, of which it is supposed that three-fourths were wasted.

It is very probable that even up to this time the borings made were not deep enough to reach the larger deposits of Petroleum, for it seems that at Stevenson Farm on Oil Creek, where borings were made to the depth of 600 and 700 feet, reservoirs were reached which gave such large quantities that the product was increased considerably.

The first oil obtained from the well of the Pennsylvania Rock Oil Company was sold at 55 cents per gallon, but prices went down afterwards on account of the large quantities of the article which was forced upon the market at a time when people were not yet prepared to put it to the many purposes for which it is now found to be available. The decline in price however did not diminish the excitement caused by the success of the first wells sunk, and the quantity of Petroleum which was shipped to Europe, although it depreciated its market value for the time, was still the cause of ultimate good, for the article being thus forced upon the public attention, the way was opened for a new and increasing demand.

Specie payments having been suspended in the spring of 1862, and the price of gold having subsequently advanced rapidly, the oil business received a great impulse, and speculation again revived. In October, the price paid in New York was fifty cents per gallon for the crude oil. It afterwards receded, but in July, 1864, it was fifty-six cents. It continued high, but with some fluctuations, until January, 1865, when crude oil was selling for forty-nine and fifty cents.

" The advance in the price of gold and exchange, " which began in the spring of 1862, and continued " until it reached its maximum in the summer and " fall of 1864, soon carried up prices to a point at " which the oil would pay all expenses of transporta- " tion, and give the owner of the well from three to " seven dollars, and at one time even ten dollars." In consequence of these high prices the oil wells became of immense value, and speculations in oil lands, and the formation of oil companies followed to an enormous extent.

Lands were bought at fabulous prices, and sold again to other speculators at still higher prices. Many of the companies formed about this time were undoubtedly got up to defraud people out of their money, for, in the confusion of the fever, matters were not investigated very closely, in fact; the mere circumstance of being engaged in the oil business, was considered a sure road to fortune. Many others, however, were honestly organized and conducted with integrity.

It is supposed that the amount of capital, at this time, applied to the purchase and development of oil territory, cannot have been less than one hundred millions of dollars.

After the civil war was brought to a close, prices began to advance abroad, owing to the increasing demand, and the Petroleum business has now assumed a permanent character as one of the branches of the regular mining industry of the United States.

The origin of Petroleum is not known with any degree of certainty. It is supposed by some to have been produced by the slow decomposition of vegetable matter in the same way, or nearly so, as coal has been formed. It is even maintained that this oil is

derived in some places from the decomposition of immense numbers of marine animals, as in Canada, where Petroleum is found in the older Silurian rocks.

Petroleum has been found in so many different strata, and the oil itself is so different in quality in different places that it is impossible to propound any certain theory as to its origin or precise locality as regards depth from the surface. It has been discovered in anthracite and calciferous beds, and even in quartz crystal regions. The limestone of Canada exudes small quantities, while the fossil coral at Watertow, New York, gives evidence of oil.* It appears on the surface of springs, it is found in the cavities of fossiliferous formations, and it is obtained from lignite by distillation, as before stated. Large deposits have been found in subcarboniferous sandstone often descending through overlying carboniferous strata. It has been remarked by a learned writer of the day, that "the transformation of woody fibre into "oil is a chemical change, taking place always out of "contact with atmospheric air and usually under "water, but by no means necessarily connected with "any particular geological period, as, for example, the "coal epoch, with which many intelligent people asso-"ciate it."

It appears certain that all Petroleum has not been generated in the same manner, nor from the same substances, as the conditions under which it is found in one region, would not at all apply to another region.

In some districts it is found in the Devonian formation, in others in the Silurian limestone. In Pennsylvania, alternate beds of the Utica slate and

* F. M. L. Gillelen: 'The Oil Regions of Pennsylvania.'

sandstone are pierced by the boring tools. Petroleum is found, in short, in rocks of all ages, from the Lower Silurian to the Tertiary period inclusive.

There where the greatest disturbance of the strata beneath has taken place, by volcanic action, the largest quantities of Petroleum have been found. This speaks well for the great probability of finding immense deposits of this oil in the cavities of the sandstone, of which the Apennines are principally composed, and which are saturated with Petroleum, for perhaps no country in the world has suffered more from the disturbing influences of internal volcanic action.

It is well known that where sandstone beds have been penetrated in search of oil, large cavities have been discovered filled with Petroleum, gas, and water. In these cases the flow upwards is great and spontaneous.

The theory which has found the greatest number of supporters, amongst scientific men, as to the origin of Petroleum, and the theory which is in fact generally adopted is, that this oil has been produced by the slow distillation, at low temperatures, of bituminous minerals. This must be a further encouragement to those capitalists who are disposed to undertake the development of Petroleum in Italy; as no other country, perhaps, is so rich in bituminous substances, which for ages have been undergoing this slow process undisturbed.

Of the many well-authenticated stories told of poor men becoming suddenly rich, through the discovery of oil deposits, none perhaps is more interesting than the following:

One of the elements of romance at all times has been the sudden elevation of individuals from penury

to wealth and social consideration. Having settled to our own satisfaction that romance is not dead, we plunge *in medias res*, that is to say, into a certain deep well near Victoria, on Lot 18, in the Second Concession of the Township of Enniskillen In that well a certain John Shaw centred all his hopes and expectations for many long months. Painfully did he dig, painfully drill, painfully pump, expending first cash and then credit, and afterwards his own muscles, on a wearisome task. Not a sign of oil did he find. His neighbours' wells were overflowing; he alone had received no share of the Petroleum stream. He found himself at last a ruined, hopeless man, jeered at by his neighbours, his pockets empty, his clothes in tatters. Report says that on a certain day he found himself unable to pursue his work; in fact, his boots had utterly given way, and to enable him to paddle about in the wet and cold, a new pair was absolutely necessary. In fear and trembling, as we may suppose, John Shaw proceeded to the neighbouring store, and having no money, asked—sad necessity—for a pair of boots on credit. Report sayeth not whether the refusal was kindly administered, in the spirit of self-defence which traders must sometimes fall back upon, or whether it was the purse-pride of the rich man looking down on his humble neighbour, but certain it is, that the boots were refused to John Shaw, and he returned to his well a sadder man than he left it, protesting that he would work no longer than that day if success did not crown his efforts; he would cast the mud of Enniskillen from his old boots, and depart to more congeniel climes. Moodily he took up his drill, and sternly struck it into the rock. Hark! what is that? A sound of liquid from the depths below,

hissing and gurgling as it escapes from the confinement of centuries. Does it cease? No; see it comes, growing in volume every moment. It fills the pipe, it fills the well; still it comes. Five minutes; ten minutes; in fifteen minutes it has reached the top of the well; it overflows; it fills a tank; it overflows that; vain are all attempts to check its career; resistless it pours in a mighty tide down the declivity into Black Creek, and is borne away by the waters to the St. Clair and the Lakes. Who shall attemt to describe the feelings of John Shaw at that moment? We shall not, for we do not know how he showed them. The bystanders have not recorded whether he wept, or whether he took off his hat and shouted "Hooray!" Anything might be excused at such a moment. We suspect that, like a philosophic Yankee, he "went to work to save the ile." But the report of the flowing well spread like wildfire through the settlement, and "John Shaw's territory" became the centre of attraction. In the morning he had been "Old Shaw;" if they had spelt his name with a P before it, they could not have described him more contemptuously. Now he was "Mr. Shaw." Congratulations poured upon him; and as he stood there, all covered with oil and mud, up came the storekeeper who had refused him the boots. The man of trade appreciated "the situation;" he bowed before the rising sun, or, rather, the flowing oil lamp, and, almost embracing the dirty luminary, he said, "My dear Mr. Shaw, isn't there anything in my store you want? if there is, just say so." What a moment for Shaw! We shall not record his answer —it was far too forcible to be polite. The well was then flowing at a rate impossible to test with accuracy,

but afterwards, when the yield was controlled, it produced two barrels of forty gallons each in a minute and a half, that is, 4,800 gallons per hour! Neither the illustrious but unknown authors of the *Arabian Nights*, nor even Alexander Dumas, drew from their or his imagination a more sudden transformation than this of John Shaw—in the morning a beggar, and in the afternoon unable to calculate the amount of his riches.

A story is also told of a young girl, who was about to be married to a peasant in her own station of life, refusing to wed him, because, in the meantime, "her dad had strick ile."

A very good description of the circumstances attending the "oil fever," was written from Oil City for the 'Morning Post,' extracts from which has been made use of by the author of 'Derrick and Drill,' a book which contains much useful and interesting information on Petroleum. The writer of the article in question says:—

"As evening closed in, the office and public "room of the Sheriff House gave abundant proof of "the prevalence of the mud. Weary men entered in "quick succession, all wearing long-legged boots, and "plastered and spattered with mud from head to foot. "Sharp, keen-eyed men were they mostly, shrewd finan- "ciers and enterprising business men from New York "and Philadelphia, with here and there a staid, cautious "merchant from Boston, looking at everything several "times before making up his mind to invest, and then "generally finding his more active and less cautious "competitors from the other cities ahead of him. Ad- "venturous speculators from the West, buying up "lands with apparent recklessness, and then grumb-

" ling at a handsome profit. Old Californians, fa-
" miliar with the rush, excitement, and crowds of
" the early gold discoveries, but standing amazed at
" the greater rush and excitement of the oil diggings.
" People anxious to buy oil territory, and people with
" oil territory anxious to sell, all crowded into the
" limited space occupied by the public room of the
" Sheriff House and all muddy, dirty, and excited
" about oil. Every chair was soon occupied, and those-
" unable to obtain seats leaned against the office
" counter or the wall. The first question asked by
" the new comer was invariably, 'Can I get a bed
" 'to-night?' and the answer invariably was, 'Don't
" 'think you can. Will see what I can do for you by-
" 'and-by.' With this all had to be content, and the
" next proceeding was to look out for a vacant chair,
" drop into it, and commence talking oil. No intro-
" ductions were needed. Every one considered himself
" privileged to seek information from any person in
" the room, and the inquiries were taken as a matter
" of course, and courteously answered. Buying and
" selling went on without cessation. A gentleman
" from New York was describing to me a piece of
" property he had that day bought, on one of the tri-
" butaries to Oil Creek, for 10,000 dollars, when my
" right-hand neighbour, whose feet were planted next
" mine on the circular stove, and who appeared as if
" dozing, suddenly brightened up, and inquired the
" exact locality of the property. Plans were produced,
" title-deeds examined, and in less than half-an-hour
" the property was resold for 14,000 dollars, the seller
" appearing very doubtful about the wisdom of his
" step. An incessant talking was going on all over
" the room, in which oil, oil, oil, was repeated with

" the monotonous iteration of the ticking of a clock.
" ' A hundred thousand dollars—oil—struck a hundred
" ' barrel well yesterday—oil—flows two hundred and
" ' sixty barrels a-day—oil—got nearly to the third
" ' sand rock—oil—been offered three millions to sell
" ' out—oil.' Such were the disjointed fragments of
" the general conversation that met my ear as I sat
" toasting my boot-heels—American fashion—against
" the iron stove.

" The large amount of the figures mentioned at
" first sounded like bombast; but a few inquiries
" as to the nature of the property bearing such high
" prices soon dissipated that impression, and fami-
" liarized me with the expanded ideas on money
" matters prevalent in the oil regions. When it is
" borne in mind that a well, producing a hundred
" barrels daily (and there are several wells on Oil
" Creek largely exceeding this product) yields a daily
" income of a thousand dollars, with no expense in the
" case of a flowing well, and but about ten dollars
" a-day if a pumping well—the original expense of
" sinking the well, including the cost of engine and
" pumps, if needed, being not over six thousand
" dollars—it is evident that the purchase of even a
" part interest in such property will require a large
" sum. When, too, it is considered that there is room
" for several such wells on an acre of ground, it will
" be seen that the mere possibility of making such
" an oil-strike greatly enhances the value of the
" land."

The writer proceeds to state that he started on foot, the following morning, up Oil Creek. Derricks peered up behind the houses of Oil City, like dismounted steeples, and oil was pumping in the back

yards. Every foot of land on the creek was considered good borable territory, and one reason alleged by the inhabitants, for not improving the town, was the fact that some day the houses will be torn down and the streets bored for oil. In the course of three years, during which the inhabitants of the town (whose site had been a barren field previous to the discovery of Petroleum) had increased to 6,000, it is said but one death had taken place. There was no burial-place, so the dead man was interred in a convenient lot. Unfortunately that lot was sold, in a few days, as oil territory, and the body was moved to another place. The second place of burial was also sold as the site for an oil well, and the body was at length shipped to Rochester, New York, to prevent its being bored through in the search for oil.

Here and there, says the same writer, were flowing wells, running from 100 to 1,000 barrels of oil a day, averaging ten dollars a barrel at the wells.

Pumping wells, forcing up from five to fifty barrels daily, were scattered thickly along the valley. The air reeked with the scent of Petroleum and gas, the mud under foot was greasy and slippery, the standing pools had the appearance of pure oil, and even the water of the creek was hidden beneath a mask of gorgeous hues, formed by the waste oil floating on its surface.

The many instances of poor men suddenly becoming the possessors of almost unlimited wealth is scarcely credible. An Irish labourer invested 300 dollars of his savings in a small lot. An oil well was struck in the vicinity of his land, and he was immediately offered 5,000 dollars for his purchase, but he would not part with it for double the amount.

A clerk obtained from his employer a slight interest in a well which was being sunk. It turned out a success, and the clerk sold his interest for 100,000 dollars. A carter received a share in another well which was about to be sunk in part-payment of his services. Oil was struck and the carter, a young man twenty-one years of age, sold his share for 150,000 dollars, and became a large landed proprietor. A man named Taylor invested the whole of his ready cash, 700 dollars, in a proposed well, and was enabled shortly afterwards to sell his interest in it for 27,000 dollars. Captain Funk, a gentleman of limited means, made 2,000,000 dollars by his speculations in oil wells. Another example of a rapid fortune being made is cited in the instance of a Methodist minister, named Van Vleek, who bought a small farm for a trifling sum, and, on Petroleum being discovered in it, he sold it out, realizing a profit of more than 100,000 dollars.

The writer already quoted says:—"In my journey "up the creek, I found, connected with the history "of many of the principal wells, instances of sudden "elevation from poverty to wealth that would scarcely "be credible, were it not for the tangible evidence "before the eyes of every one. Standing before a "flowing well, gushing out oil at the rate of 6,000 "dollars a day, without other expense to the pro- "prietors than the original sinking of the hole, and "the hire of two or three men to take care of the "oil, it was easy to believe any story—however mar- "velous—of rapidly acquired riches."

One of the theories in most favour with practical men in America, with regard to the origin of Petroleum, is, that the present oil beds were once salt

marshes, covered with rank and salt vegetation. The subsidence of the earth's surface covered this vegetation with layers of sand, which, in process of time, hardened into sandstone, holding the vegetation prisoner. The hermetical imprisonment of the vegetation prevented its decomposition in the ordinary manner, and it was slowly distilled in the rock alembic. The component parts into which it was resolved —salt water, oil, and gas—gathered in the cracks and cavities of the rock, where it lay awaiting for ages its release from bondage by the operation of the miner's drill. From their difference in specific gravity it is assumed that the water lies at the bottom of the cavity, the oil next above, and the gas over all. If this was the invariable rule, and the cavity was of regular shape, the drill, in striking a cavity, would first liberate the gas, then the oil would have to be pumped out, and in the end the pump would draw nothing but water. The very many departures from this arrangement is accounted for on the hypothesis that, from the irregular shape of the cavities, the boring tool might first penetrate the middle, or oil-section, when the rush of gas to the hole would force up the oil, and thus cause a flowing well. After the gas had escaped, the flow would cease, and the remainder of the oil could only be extracted by the pump. That wells are not totally exhausted is accounted for by the fact that the deposits are fed by minute channels, through which the oil forces its way from other deposits. In America it would seem that the principal oil deposits are contained in the third stratum of sandstone, and in this rock the greatest flowing wells have been found, although oil has frequently been met with in considerable quan-

tities in the second sandstone, and sometimes even in the first. The strata which separate the sandstones from each other are for the most part composed of shale. The depth at which the third sandstone is reached varies from 300 to 800 feet, and in some instances to 1,000 feet. In Italy it is supposed that the oil deposits will be reached at from 300 to 600 feet.

A curious account of the fortune that befel a man named Tarr, who held a farm on Oil Creek, is given in 'Derrick and Drill.' Previous to the Petroleum excitement, this man Tarr was in great straits, his business of rafting lumber, in addition to the cultivation of his miserable acres, scarcely yielding enough to support himself and family in the humble way in which they lived. Like most of the other residents on the creek, the owner of the Tarr farm scratched over his land, and raised a scanty crop between the intervals of rafting lumber to Pittsburgh, and hunting rabbits in the hill on Sundays. But the oil adventurers came along and secured a right to bore, giving half the oil to the landowner. The result was that oil was struck, and the well yielded over 2,000 barrels daily, which, even at the moderate price then current, yielded a magnificent revenue to the well owner, and also to Tarr. Other wells were sunk and met with great success; so that the poor lumberman and farmer speedily grew rich. In August, 1863, when the price of Petroleum ruled low, Tarr sold half the interest in his land and one-eighth the oil interest of his farm for 110,000 dollars each, and retired to a handsome residence in the adjoining county. The remaining interest in his land and wells increased in value until his daily income was counted by thousands of dollars. He afterwards sold

out his remaining interest on the creek for 2,000,000 dollars, at which price he considered himself throwing the property away.

Another man, named Mr. Elhenny, was very fortunate; he struck oil, and his well (called the Empire Well) was unprecedented in the flow of Petroleum. The boring tools were no sooner taken out than the oil rushed up in a mighty volume, the flow being equal to three thousand barrels a-day! The owner and his partners were bewildered. What to do with such a tremendous rush of good fortune was a problem they could not solve. It was altogether too much of a good thing. The uses to which Petroleum was put were as yet but few, the true value of the product not having been discovered. One day's flow of "The "Empire" was almost enough to supply the total consumption for a week. There was also a difficulty at that time of getting so large a quantity to market. There were not barrels enough on Oil Creek or in its vicinity to contain a single day's product of the wells already flowing. The whole of the coopers of the surrounding country were employed day and night in making barrels at high wages, but they were not sufficient to supply one-tenth of the barrels required. The tanks and vats hastily improvised were soon filled; pits were dug, and speedily overflowed; and at length the stream of oil was turned into the creek, forming a thick coating on the water. The Empire well continued flowing, and, when new uses were found for the Petroleum, the increased price brought great wealth to the owners.

Another man named Sherman, with a small capital, sunk a well, the yield of which was 1,500 barrels a-day at first; it afterwards fell to 700 barrels, at

which rate it remained steady. This man's property was valued at 2,000,000 dollars.

Oil was struck at another place, not far from Sherman's well, and the quantity which flowed was estimated at 2,500 barrels a-day! The oil spouted into the air to the height of fifty feet, accompanied with a roar like that of a hurricane. It was impossible, for several days, to bring it under control, and thousands of barrels of oil were wasted. In short, the number of cases in which large fortunes have been made, not only by flowing wells but also by pumping wells, would fill a volume.

In whatever way Petroleum may have been formed, it is very certain that water and fire have been the principal agents in all countries which have helped to cause so many changes in the surface of the earth. By these forces, in Italy as well as in America, rocks have been torn asunder, the several strata have been disturbed, internal cavities have been formed, mountains have been raised where once were valleys, and valleys have taken the place of mountains. In America Petroleum is found in the bituminous substances and in the cavities of sandstone rocks. As already stated, there are three strata of sandstone separated from each other by slate. In the third sandstone, at a depth of from 300 to 800 feet, the great basins of oil are found; those basins which have caused a revolution in ordinary commercial affairs in Pennsylvania. In the first sandstone rock, which generally lies at a depth of from 60 to 150 feet from the surface, is found what is called the surface oil. In Western Virginia it is stated that the surface wells were very successful, but not so in Pennsylvania, where it was necessary in most cases to bore deep.

The Petroleum zones or belts extend for miles in several places in America.—In Italy along the Apennines in Reggio and Modena, and in other provinces, but to a lesser extent as far as we have any knowledge.

What are called flowing wells, that is, wells from which the oil issues spontaneously without being pumped up, do not as a general rule flow continuously. In many wells the time of flow and the interval of quiet rarely vary over one or two minutes. This movement exactly corresponds with the intermittent agitations from the Salse di Querzolo and those of Sassuolo already described.

If the Petroleum which is to be found in so many parts of the world were developed to the same extent as that of the United States, it is feared by many that the vastly increased quantities would render the article so cheap as to be no longer a profitable business for capitalists and dealers, but, as the oil increases, the uses to which it will be applied will no doubt be augmented in proportion. Professor Wright, speaking on this subject, says:—

"If all the sources of oil were in active operation, "there need be no fear of an over-supply, for the "many uses to which its different constituents are "applied, and the new applications that are made of "it almost every day, will, for all the time to come, "make the demand greater than the supply. The "employment of coal-oil as a substitute for coal by "ocean steamships, would consume all that is now "procured in Pennsylvania. Already a patent for "this purpose has been applied for in England. Fuel "of this kind will enable a ship to steam from New "York to China, without stopping for a fresh supply;

" the bulk being much less, and the heating power
" more intense. Nearly fifty different products and
" educts have been already obtained from Petroleum,
" and many more will undoubtedly be discovered,
" which will still further enhance the value of this
" truly protean substance."

EXTRACTS FROM THE PUBLIC PRESS.

THE following extracts from the public press are inserted here to show that some of the first newspapers of the day, both in England and in Italy, have deemed the subject of Petroleum in the latter country of sufficient importance to discuss it in their columns.

Dei Prodotti di Varie Arti ed Industrie inviata All' Esposizione Universale del 1867 *in Parigi Relazione della Sottocommissione Industriale di Firenze al Ministro di Agricoltura, Industria e Commercio Presidente della Commissione Reale Italiana.*

Petrolj.

L' olio minerale che ha, da qualche tempo, surrogato, attese le buone condizioni di economia che presenta, l'o lio vegetale, nel consumo delle famiglie e di molti pubblici stabilimenti, venne scoperto anche in diversi punti del suolo italiano. Varj saggi del prodotto di solerti tentativi sono stati offerti per parte dell' espositore seguente:—

FAIRMAN ST. JOHN, SIR EDWARD (Inglese).

Bottiglie, chiuse in cassetta di latta, contenenti dei saggi di petrolio, al suo stato naturale, estratto da pozzi scavati nei Comuni di Miano e Neviano (Prov. di Parma), e di Monte Gibbio e Frignano (Prov. di Modena).

Il signor Cav. Fairman, membro della Accademia Geologica di Francia e della Società di scienze naturali in Milano, ha aderito al

desiderio manifestatogli da questa Sottocommissione inviando ad essa dettagliate notizie circa ai suoi prodotti, le quali, atteso la grande utilità che possono presentare, crediamo ottima cosa riprodurre genuinamente.

Saggio N° 1.—Nel Comune di Frignano, provincia di Modena, lungo le due sponde del *Rio di Pedrocchio*, confluente col *Pescaro*, in una direzione Est-ovest trovasi una zona di terreno copiosamente imbevuto di petrolio, talchè, a pochi metri di profondità, affluisce da strati pliocenici di sabbie compatte e di arenarie. La forma di questa zona di terreno, la sua giacitura e stratificazione, prestano un criterio abbastanza chiaro per accertarsi di quanto siano ricchi di olio minerale gli strati inferiori, ed è perciò che molti scienziati si trovarono unanimi nel ritenere che esiste in questa località una fonte di ricchezza per la provincia di cui fa parte. Il signor Fairman, proprietario di varj fondi situati in quei paesi, vi scoperse antichi pozzi a petrolio, poco profondi, già coperti di frane e sconosciuti a tutti, dai quali, anche al presente, si trae un bellissimo olio simile alla *nafta*.

Saggio N° 2.—Nella provincia di Modena trovasi Monte Gibio, detto una volta Monte Zibbibo per l' abbondanza dell' uva di talb nome che in esso si coltivava. La sua distanza è di circa tre chilometri dalla piccola città di Sassuolo e fa parte del Comune della medesima. Sulla vetta havvi un antico castello, che domina le falde di questo monte rinomato sino da' tempi antichissimi per il vulcano di *fango* o *salsa* che trovasi nelle chine a settentrione, ora di proprietà del signor Fairman, la quale da alcuni è anche detta *Salsa di Sassuolo*. Vicino al castello scorre un rio, che, da tempo remoto, per l' ingente rovina che faceva, si acquistò l' epiteto *delle rovine* e del quale fa menzione Plinio al lib. 2, della Storia Naturale.

La *Salsa di Monte Gibbio* nelle sue eruzioni (delle quali per singolari fenomeni meritano ricordo non solo quelle rammentate dallo stesso Plinio ma ancora quelle avvenute nel 1771 e nel 1835) chiamò sempre l' attenzione dei più accreditati naturalisti, ai quali nel tempo stesso non passò inosservato il petrolio esistente in questa località. Anzi il petrolio di *Monte Gibbio*, conosciuto da lungo tempo, fu decantato da Serapione, che ai suoi tempi veniva chiamato *il sottilissimo investigatore delle cose semplici*, non che dall' antichissimo e rinomato fisico Dioscoride. Anche gli scritti di Francesco Ariosto trattano estesamente di questo petrolio, delle sue proprietà fisiche, chimiche ed igieniche. Il signor Fairman in questi ultimi anni fece ogni sforzo per dare tutta l' importanza

che poteva meritarsi, al petrolio di *Monte Gibbio* di maniera che al dì d' oggi non pochi capitalisti rivolsero lo sguardo a quelle zone petrolifere.

In *Monte Gibbio*, abbondano di petrolio non solo alcuni strati di transizione, costituiti da sabbie grossolane e da marne carbonose mescolate a bitume, che lo rendono di colore oscuro, ma affluisce copiosissimo e limpido anche da strati di terreno terziario superiore, inferiormente composto da marna azzurra contenente in qualche punto moltissime conchiglie proprie di questo terreno.

La zona più ricca di petrolio in *Monte Gibbio* è quella che, partendo dalla *salsa*, attraversa il *rio delle rovine* e si estende lungo il fosso denominato la Serra sino all' incontro del rio detto di Monte Gibbio, vicino al quale, quasi a fior di terra, trovansi diverse sorgenti a petrolio. La vicinanza di Sassuolo, la poca distanza da Modene, non che le vicine e comode strade crescono il merito a questa sostanza e ne agevolano il commercio.

Saggio N° 3.—A Neviano de' Rossi, Comune di Fornovo di Zaro, parte montuosa della provincia di Parma, a meriggio della chiesa del villaggio di questo nome esiste una piccola valle circoscritta da sentite preminenze dal nord all' est sino al sud, aperta dalla parte ovest ed attraversata dall' impluvio delle falde vicine. In questa piccola valle trovansi attualmente pozzi a petrolio, e, camminando nella direzione di Fornovo, scorgonsi dati abbastanza palesi per credervi esistere un terreno fecondo di questo carburo-idrogenico liquido; ma nei luoghi più limitrofi alla suddetta valle, sebbene gli strati miocenici sembrino i più ricchi di petrolio, nullameno questo, per la sua abbondanza, si rende manifesto persino alla superficie del suolo, talchè nei tempi di pioggia vedesi l' acqua scorrere nei ruscelli accompagnata dall' olio anzidetto.

Nei pozzi attuali, che fecero ricchi i loro proprietari, alla profondità di 34 metri circa, da una marna azzurra, divisa in tante piccole falde, affluisce, accompagnato da acqua un petrolio chiaro debolmente colorato in giallo cangiante-azzurro, che senza depurazione alcuna, presta, se non superiori, almeno gli stessi servizi dei petrolj esteri depurati. Fra le altre sue qualità il petrolio di Neviano ha quella di essere fornito di un odore, abbenchè bituminoso, non disgradevole ed anzi tendente all' aromatico. Sebbene il paese di Neviano de' Rossi abbia sin qui goduto in piccola parte dei vantaggi delle sue sorgenti a petrolio, ciò non ostante l'attenzione di uomini intraprendenti renderà ben presto manifesta una ricchezza che fu appena conosciuta al giorno d' oggi.

Saggi N° 4, 5, *e* 6.—La zona di terreno, della quale fa parte

in special modo il Comune di Medesano, può dirsi irrigata quasi alla superficie da rivi di petrolio; tanto copiosamente trovasi essa imbevuta di tale prodotto: però il villaggio di Miano è il più fecondo e ricco di olio minerale. Quivi sono molte sorgenti, parte naturali e parte artificiali; la qualità più pura trovasi a settentrione del villaggio suddetto, mentre negli altri punti il petrolio ricavasi meno puro, tenendo in soluzione del bitume che gli comunica un colore giallo-scuro o rossastro, con odore molto piccante. In certi punti, e nella parte più a levante, il petrolio esce con sorgenti d' acqua, accompagnato da un bitume nero simile al *Goudron*, ed esalante un odore penetrantissimo, in altre sorgenti si sviluppa gaz idrogeno carbonato, il quale sembra essere l' unica cagione dei rombi sotterranei che di frequente sentonsi in quelle località.

Il suolo è costituito di arenarie a cemento argilloso poco calcare e coerente; vi abbondano pure marne argillose, debolmente calcari, nelle quali più diffuse trovasi il petrolio, anzi, nei pozzi quivi praticati, quest' olio minerale zampilla precisamente nelle sfaldature di quelle marne, spessissimo interrotte da arenarie calcari rosse e da marna nerissima.

Questi sono gl' interessanti dettagli che ci vennero forniti e noi facciamo voti perchè questa vera ricchezza del nostro suolo, utilizzata ben presto in commercio, emancipi il paese nostro da quella specie di tributo, che, per l' uso del petrolio reso omai comunissimo, esso deve pagare ad estere nazioni.*

Il Lavoro, Giornale di Educazione Popolare, si pubblica in Pisa nelle ore pomeridiane di ogni Sabato.

PETROLIO NAZIONALE.

Mentre che noi Italiani lasciamo a se stesse moltissime industrie ed intraprese che potrebbero recare vantaggiosissimi lucri a coloro che se ne mettessero a capo, ed interessi immensi allo stato, alcuni stranieri approfittando della nostra inerzia, col loro studio, colla

* Il signor Cav. Fairman sta per costituire, appunto, una società per la escavazione dei petrolj, radunando capitali italiani. Egli ebbe l' onore di esporre questi suoi divisamenti a S. M. il Re che volle concedergli il permesso d' intitolare col suo Augusto Nome la nuova intrapresa, ed in attestato di benemerenza alle cure del distinto geologo conferì a questo la croce dei Santi Maurizio e Lazzaro.

loro buona volontà sono giunti al punto di trovare dei fonti di ricchezze nello scoprimento e nel miglioramento dei nostri prodotti nazionali. Così in Sicilia un Belga, l' ingegnere Giulio Ferdinando Prunfont, ha già introdotto l' uso di una macchina per fondere i zolfi, colla quale promette una spesa minore di fusione, ed una produzione di gran lunga maggiore a quella già ottenuta per mezzo dei calcaroni e delle calcarelle, e quel che è più, assicurerebbe la combustione in tutte le stagioni, senza nocumento dell' agricoltura dei fondi prossimi alle miniere.

Nella provincia di Modena l' Inglese Sig. Edoardo Fairman, dopo lunghi e diligenti studi, avrebbe scoperta e constatata l' esistenza di miniere di petrolio, dalle quali ove si giungesse ad escavarle s' otterrebbero resultati splendidissimi. Il Sig. Fairman che sta a questo fine formando una società di capitalisti, è già stato preso in considerazione dal nostro governo, dal quale ha ricevuta la croce di cavaliere dell' ordine dei SS. Maurizio e Lazzaro; ma pero vogliamo sperare che ove ne sia veramente riconosciuta l' importanza, i poteri supremi dello stato non si limiteranno alle sole onorificenze, ma verranno in soccorso di chi con coraggio ed abnegazione si mette sulla strada di giovare al paese, col dare sviluppo alle industrie e al commercio.

Il cav. Fairman non è italiano, ma l' affetto e la simpatia che nutre per l' Italia è tale che siamo certi, che ove la fortuna e il concorso di chi puo dedicare dei fondi a questa non dubbia intrapresa non gli vengano meno, saprà ben corrispondere alla fiducia che in lui è stata riposta. Sappiamo intanto che un ricco intendente di questa materia di New-Jork ha già visitato i luoghi acquistati dal sig. Fairman, e vi ha constatato l' esistenza di petrolio di ottima qualità.

Ancora la Facoltà Chimica di Napoli ha esaminati tre barili di olio minerale proveniente da una miniera che a sue spese si sta esplorando. I resultamenti sarebbero buoni, sia per l' olio da bruciare sia per l' olio grasso ed altri prodotti utili. Esso contiene l' 85 % d' olio da bruciare, qualità che lo mette al disopra di molti petroli stranieri.

Impiegato come combustibile allo stato greggio, questo petrolio ha dato un sostituto vantaggioso al carbon fossile.

In tal guisa sarebbero già due provincie del Regno in cui esisterebbe petrolio. Dio voglia che il libero incremento dell' industria, e l' apprezzamento dei molteplici prodotti del nostro fertilissimo suolo, crescano vie maggiormente, per divenire, con più facilità a sciogliere l'arduo problema della nostra questione economico-finan-

ziaria. Ed allorquando in Italia avremo il Cotone, il Petrolio, ed altri molti prodotti che per adesso ci vengono dalla fortunatissima America, allora la vita commerciale potrà riprendere forza e vigore, e ci sarà dato rifarci dei sacrifici sostenuti per raggiungere l' indipendenza e l' unità nazionale.

G. P.

The 'TIMES' *of the 2nd February*, 1866, *in their Correspondent's letter from Florence, dated January 28th*, 1866, *says*—

"As regards Petroleum, there seem good grounds for believing that it exists, in certain Italian provinces, in sufficient quantities to make it well worth searching for. The so-called 'Salsa di Querzola' is about eight miles from Reggio (Emilia) on the slope of a mountain in the commune of Viano, having the Faggiano torrent to the north. The nature of the ground is pliocenic-volcanic, and the patch in question includes nine volcanettes, or, as they are here technically called, *salse*, which are in continual eruption, throwing up to a height of 4 ft. or 5 ft. a semi-fluid mud or silt, with traces of Petroleum floating on the surface. Occasionally masses of lignite are likewise thrown up. Three of the *salse* are flowing volcanettes, the matter ejected merely overflowing the crater, or mouth. The Salsa di Querzola is not, it appears, the property of a company, but of a Mr. Fairman, an English geologist, whose attention has been particularly turned to the subject of Petroleum in Italy, and who apparently considers the *salsa* in question to be important from a speculative as well as from a scientific point of view. Besides visiting the localities already known as oil producing, he has sought out others, and, in the course of his researches, he has repeatedly recognised the presence of copper, iron, loadstone, mercury, and lignite. There can be no doubt that Italy is very rich in mineral productions, and this source of natural industrial wealth has hitherto been but imperfectly and partially developed. Petroleum is now enormously consumed in this country, and if, as there is strong reason to believe, it exists in large quantities in Italy, it may become of immense importance as an article not only of home use, but of lucrative export."

The 'NAZIONE' (*Italian Official Paper, published in Florence*), *Florence*, 10*th February*, 1866.

[TRANSLATION.]

"PETROLEUM IN ITALY.—The existence of Petroleum in Italy is a question of great interest, and our readers will learn with pleasure that it is assuming a vast importance both in a scientific as in a speculative point of view. Amongst the other distinguished geologists who have devoted their time and attention to this study may be particularly noticed Mr. Fairman, an Englishman, resident for some time in Italy, and who has paid special attention to this branch of his science, and who, besides having visited the localities already known for many years past as oil-bearing, has increased the number by discovering several others of great importance. In many of the lands visited by him in his geological excursions he has also recognised the presence of copper, iron, mercury, asbestos, lead and lignite.

"Italy is a country of great interest with respect to its mineral productions, but this branch of natural industrial wealth has only hitherto been developed to a very small extent. Should these discoveries of Petroleum attract the attention which they deserve, and the Italian Government perceive the great advantage which will be derived therefrom, will favour, by all the means of which it can dispose the efforts of those enterprises formed to develop it, the production of Petroleum will give important results, not only to Italy, but even to England, which will derive a certain advantage by being no longer dependent on America and other far distant countries for its supply of Petroleum."

The 'UNITA ITALIANA' (*published in Milan*), 24*th March*, 1866, *says*—

[TRANSLATION.]

"We have read in No. 57 of the 'Sole,' under the title of 'The Petroleum Springs,' the following lines:—thus—In the Province of Modena, a new industry promises brilliant results to speculators.

"Upon the traces already known, has been discovered a vast zone of Petroleum-bearing lands, Petroleum has been gathered there

from *time immemorial*, but from the many wells only one has been looked after, on Monte Gibbio. By order of the Provincial Council a commission was appointed, composed of Professors Callegari, Canestrini, and Manzini, in order to undertake researches to determine if the natural springs offered sufficient indications to warrant the invitation of large capital, and to give results, if not of certain importance, at least probably so.

"The report of these scientific men gave the very best promise, and their studies have revealed riches of which hitherto we had but uncertain data, vague and traditional idea. Callegari and Canestrini are now publishing, in the 'Panaro,' a journal of Modena, a report on the Petroleum of the Province of Modena, by the which, written in a style adapted to the intelligence of all, they endeavour to awaken the desire to usefully develop this interesting natural production. They have decided, in fact have assured us, that from the very first lines, Petroleum exists in that province in large quantities, and that works conducted according to scientific principles and the perfected means of present art, would produce, even amongst us, as fabulous profits as with the Americans.

"Whilst we invite capitalists not to let the opportunity pass to make a fortune, we congratulate, with all our heart, these two professors, whose names must remain inseparable from the history of new and great enterprises, which, no doubt, will be vast and fortunate."

The 'Oil Trade Review,' *4th August*, 1866.

"Italian Petroleum.—We have been favoured by Mr. E. St. John Fairman with four samples of Petroleum taken from some wells sunk in Parma and Modena. These samples are very remarkable for their natural purity, several of them being as transparent as the best refined coal oil. They are, in fact, the first samples of transparent crude oil which have come under our notice, and if the yield of the additional wells which we hear it is intended to sink is considerable, the Italian oil will, without doubt, become an important article of commerce. Mr. Fairman, who has spent a considerable time in 'prospecting' in the provinces of Reggio and Modena, reports the existence of Petroleum in more than a hundred localities, and he has secured mineral rights over the best among them. The wonderful transparency of the oil is accounted for in the fact that it undergoes a natural process of filtration

through a stratum of very loose grey sandstone rock, for in parts where it has accumulated in the fissures of shale—which also exists there—without passing through the sandstone, it has a very similar appearance to American Petroleum, although it is much thinner. One of the samples submitted to us was collected at a depth of from three to six metres from the surface, and, indeed, may be considered to be surface oil. In the other localities, however, wells have been sunk to depths of from thirty-two to forty-five metres. The properties secured by Mr. Fairman are about 150 acres in extent, and we are informed that it is intended to form a joint-stock company in England to develop the oil. The springs continually emit mud and silt, and oil has been found floating on the water. The rocks, in all cases, are, it is stated, either of the eocene, miocene, or pliocene groups of the tertiary formation, and the specimens of sandstone brought to us with the samples of oil have been impregnated with Petroleum. The report of 'A gentleman whose views are practical and merit attention,' states that surface Petroleum—mud springs—accompanied with 'breath of oil,' or hydrocarbon gas, marl, and porous rock strongly impregnated with oil, salt and magnesia deposit, magnesian and sulphuretted hydrogen springs—in fact, all the indications which have hitherto proved the existence of a rich oil territory—are here found. The surface Petroleum, collected from various springs, is of a high specific gravity, and remarkably free from carbon, proving that it has permeated through a comparatively shaly or soft strata; easy boring may, therefore, be anticipated. The samples, which are small in bulk, may be examined at the office of 'The Oil Trade Review' by any one who takes an interest in the subject In the meantime, we have received a promise that large samples will be forwarded to us from Pisa in order that we may have an opportunity of testing the precise qualities of the oil."

The 'MINING JOURNAL,' *8th September*, 1866.

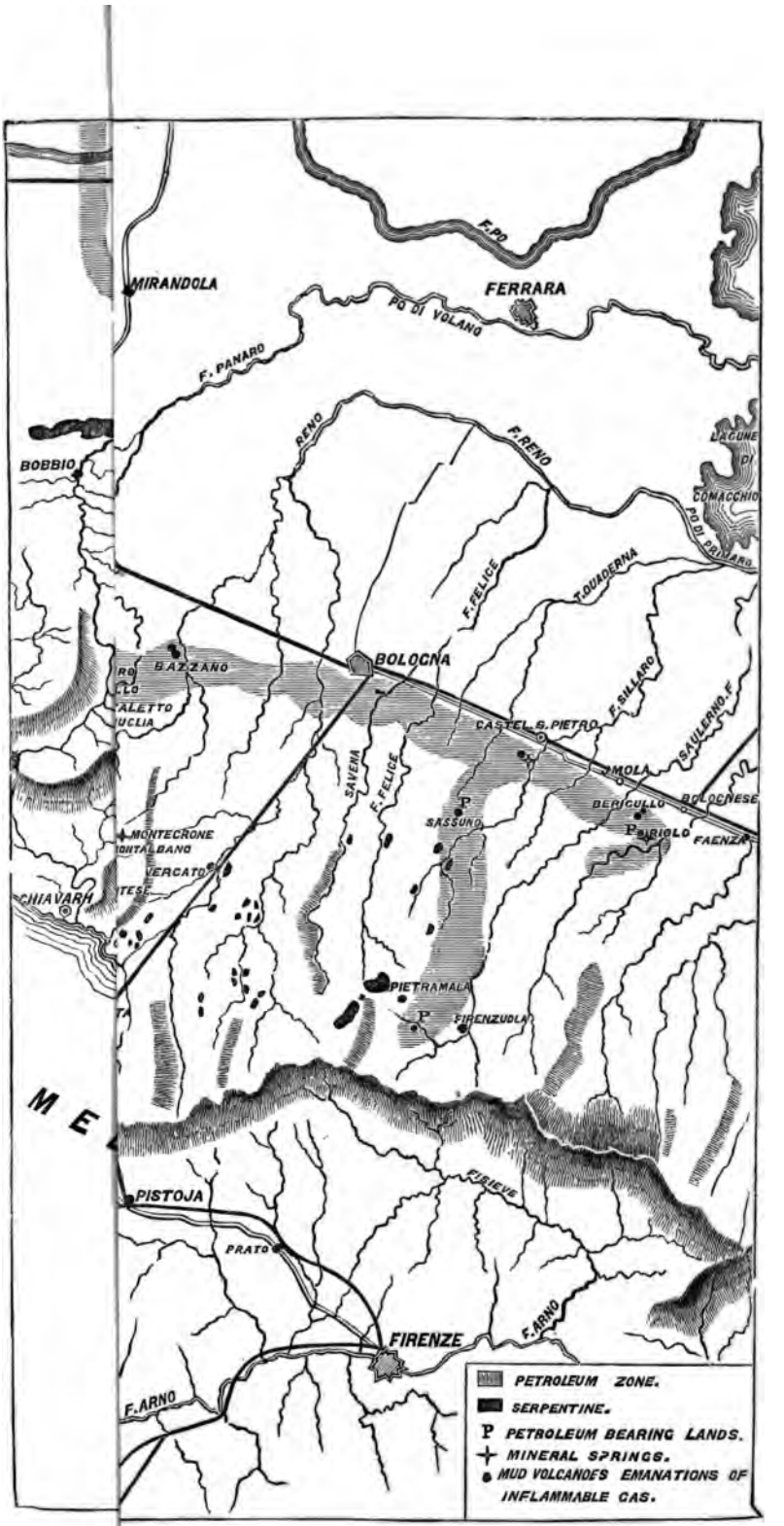
"PETROLEUM IN ITALY.—In a former journal we mentioned the fact of the discovery in Northern Italy of some important Petroleum-bearing lands. We have since been favoured, by Mr. E. St. John Fairman, F.G.S., Fellow of the Geological Societies of France and Milan, with a few memoranda, which we publish as likely to interest those of our readers who follow this important question of Petroleum. We hope at an early date to be able to produce in

our columns the map of the districts showing the strike of the Petroleum zone, which Mr. Fairman has promised to hand us when completed, as also to quote extracts from the pamphlet which he is at present occupied in arranging.

"Having devoted considerable time and labour to the subject, and experienced those pleasing delights which only those appreciate who have travelled on foot for months over the Italian mountains, and waded through the brooks and torrents so numerous in those provinces, living, or rather existing, on the famous 'polenta,' and new red wine, a mixture to be supposed highly conducive to cholera, he returned, and pronounced 134 different localities in the provinces of Parma, Reggio, and Modena as rich Petroleum-producing tracts.

"The importance of his labours attracted the attention not only of the provinces, but likewise that of the Government, and the result obtained for him most flattering appreciation in the country and from the local press. The Government, convinced of the benefit that the country would derive from the development of its own buried resources, passed a law (May 1, 1866), raising the duty on refined Petroleum from 2 francs to 6 francs per 100 kilogrammes. We shall, no doubt, see that Italian Petroleum will become ere long an important article of commerce. Our contemporary, the authority of the day on oil matters, writing on Aug. 4, asserts that 'the samples are very remarkable for their natural purity, several of them being as transparent crude oil which have come under our notice.'"

"Many Petroleum wells have existed in these provinces for centuries, and are referred to by Herodotus, Pliny, Humboldt, Spallanzani, Valisneri, &c., and in the works of many modern geologists. Only about thirty years ago a trial was made, and good results were obtained in the provinces of Piacenza, when twenty-two common brick wells were sunk to from 45 to 75 metres, and they produce on an average 25 kilogrammes of oil per diem. In 1802 the city of Genoa was lighted with Petroleum from Miano. The famous theatre at Reggio was also illuminated with the mineral oil from the wells of Montegibbio. In older times one well at Sant' Andrea, at a depth of 70 metres, produced 100 pesi per diem (25 lbs. per pesi); this well fell in through bad brickwork. At Miano one well, 73 metres deep, contained 125 feet of oil. The oil merely filters or drips into the well, no mechanical appliances other than a rude bucket and rope being used to obtain it. The diameter of the wells is generally about $1\frac{1}{2}$ metre; it is


F. Po
MIRANDOLA
FERRARA
Po di Volano
F. Panaro
Reno
F. Reno
BOBBIO
Lagune di Comacchio
Po di Primaro
F. Felice
Quaderna
BOLOGNA
S. AZZANO
F. Sillaro
Saulerno F.
CASTEL S. PIETRO
IMOLA
Bolognese
Savena
F. Felice
SASSUNO
BERICULLO
RIOLO
FAENZA
MONTECRONE
VERCATO
PIETRAMALA
FIRENZUOLA
PISTOJA
Fusieve
PRATO
FIRENZE
F. Arno
F. Arno
PETROLEUM ZONE.
SERPENTINE.
P PETROLEUM BEARING LANDS.
MINERAL SPRINGS.
MUD VOLCANOES EMANATIONS OF INFLAMMABLE GAS.

now sold to dealers in Milan, Parma, Reggio, Modena, and Sassualo, and may be seen burning in many a lamp, and is known generally by the name of 'lucilina,' and the inhabitants of the villages in the vicinity of the wells are at the present day burning these oils in their *crude state*. In the days of the dukes, the exduchies produced annually about 24,000 kilogrammes of oil, which, selling at 2·50 frs. per kilogramme, gave to the province an income of 60,000 frs. Large quantities were shipped to Greece during the War of Independence to prime their fire-ships."

The 'Oil Trade Review' *says*—

"The Italian Petroleum Area.—In another page we publish a map of the Petroleum area in Italy, referred to in a previous number of 'The Oil Trade Review.' We have been favoured by Mr. St. John Fairman—whose interest in a large portion of the area we have already explained—with the drawing. The samples of natural oil left at this office have been examined with much interest by a great many persons connected with the trade, many of whom are very loth to believe that these beautiful specimens of natural oil have not undergone the refining process. Really transparent crude oil is so little known, and, we believe, exists only in Italy, that we are not surprised at their incredulity; but no doubt whatever exists that this oil has been known for ages."

LONDON: PRINTED BY W. CLOWES AND SONS, STAMFORD STREET AND CHARING CROSS.